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University of the State of New York Bulletin

Application for entry as second-class matter at the Post Office at Albany, N. Y., pending

Published fortnightly

No. 538 ALBANY, N. Y. MARCH 1, 1913

New York State Museum

JOHN M. CLARKE, Director

Museum Bulletin 164

NINTH REPORT OF THE DIRECTOR OF THE SCIENCE DIVISION

INCLUDING THE

66th REPORT OF THE STATE MUSEUM, THE 32d REPORT OF THE STATE GEOLOGIST, AND THE REPORT OF THE STATE PALEONTOLOGIST FOR 1912

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ALBANY

UNIVERSITY OF THE STATE OF NEW YORK

1913

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New York State Education Department
Science Division, February 13, 1913

Hon. Andrew S. Draper LL.D.
Commissioner of Education

SIR: I have the honor to transmit herewith the manuscript and accompanying illustrations of the annual report of the Director of the Science Division, for the fiscal year ending September 30, 1912, and I recommend the same for publication as a bulletin of the State Museum.

Very respectfully
JOHN M. CLARKE
Director

STATE OF NEW YORK
EDUCATION DEPARTMENT
COMMISSIONER'S ROOM

Approved for publication this 19th day of February 1913

A. S. Draper

Commissioner of Education

Education Department Bulletin

Published fortnightly by the University of the State of New York

Entered as second-class matter June 24, 1908, at the Post Office at Albany, N. Y., under the act of July 16, 1894

No. 538 ALBANY, N. Y. March 1, 1913

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John M. Clarke, Director

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66th REPORT OF THE STATE MUSEUM, THE 32d REPORT OF THE STATE GEOLOGIST, AND THE REPORT OF THE STATE PALEONTOLOGIST FOR 1912

INTRODUCTION

This report covers all divisions of the scientific work under the charge of the Education Department and concerns the progress made therein during the fiscal year 1911–12. It constitutes the 66th annual report of the State Museum and is introductory to all the scientific memoirs, bulletins and other publications issued from this office during the year mentioned.

Under the action of the Regents of the University (April 26, 1904) the work of the Science Division is "under the immediate supervision of the Commissioner of Education," and the advisory committee of the Board of Regents of the University having the affairs of this division in charge are the Honorables: Daniel Beach LL.D., Watkins; Lucius N. Littauer B.A., Gloversville; Adelbert Moot, Buffalo.

The subjects to be presented in this report are considered under the following chapters:

I State Museum Law
II The Educational Function of the State Museum of Science
III Condition of the Scientific Collections
IV Report on the Geological Survey
V Report of the State Botanist

VI Report of the State Entomologist
VII Report on the Zoology Section
VIII Report on the Archeology Section
IX Publications of the year
X Staff of the Science Division and State Museum
XI Accessions to the Collections
XII Appendixes (to be continued in subsequent volumes).. All the scientific publications of the year.

I

THE STATE MUSEUM LAW

The present attitude of the State of New York toward its museum is defined in the statute enacted in 1889 and incorporated without change in the codified Education Law of 1910:

All scientific specimens and collections, works of art, objects of historic interest and similar property appropriate to a general museum, if owned by the State and not placed in other custody by a special law, shall constitute the State Museum.

This provision for the existence of a State Museum is brief and precise, but the conception which lies behind it is broad, enlightened and efficient. Provision is made, not alone for a museum of science, even though to the present day the science museum only has received recognition and support by actual allotments from the Legislature. The law is broader than the present exercise of that law and the genius of the brief enactment cited rises above the actual condition attained by virtue of it.

THE STATUTORY CONCEPTION OF A "STATE MUSEUM"

The letter and evident spirit of the law provide not only for the museum that now exists, but for any public museum which the people of the State may choose to bring into existence, whether it be a museum of history, of art, of industry, or of education; and all such museums and their materials shall constitute the *State Museum*. The statute clearly opens the way for the institution, at the will of the people, of a series of museums or departments of a State Museum, as many in number and nature as the reasonable demands of a populous, wealthy and intellectual state may regard essential to the instruction of its people. No law for the establishment of public museums could be broader in import or susceptible of a more generous interpretation in strict accord with the expressed wishes of the people. It is the deliberate expression

of the Legislature of the State that a place be provided in its polity, not alone for the museum of science, which has been in existence for sixty years, but for additional museums, as their need may become appreciated, all under the control of the Education Department. This is clearly the meaning of a law which, in state legislation on this subject, is not surpassed for conciseness and breadth.

THE STATE MUSEUM IDEA AND ITS PLACE IN THE POLITY OF THE STATE

This State has thus far developed its magnanimous conception of the *Museum* only along the line of science. So far as it has gone it has doubtless done well in this single direction, for its museum of science has brought credit to it and to those who have shared in its development. The State Museum of Natural History has achieved a distinctive and worthy repute among such scientific museums whose interests are of necessity somewhat restricted by political boundary lines. It is very doubtful if any state museum of science should attempt to enter the wider field of the world and thus compete with the great privately endowed museums of the larger municipalities. Its function is well and adequately defined in portraying in fulness the natural resources of its state. The good repute of the New York State Museum of science has come, however, more from the work of original research which it has fostered, than from the educational service thus far rendered through its collections. These collections have been assembled very largely for the service of the investigations, rather than with the purpose of elucidating to the people the significance of these researches. So far is this the case that the science museum, now entering a new building with capacious and well-equipped halls, finds itself deficient, not in the quantity but in the quality of scientific materials suitable to display to the public or competent lucidly to explain the facts they represent and the researches which the Museum has prosecuted. This is a condition which must be remedied if this Museum is to become a vigorous arm of the educational service. In a very real sense the science museum, notwithstanding its long history and its large collections, is beginning anew, for never within its history has it possessed a satisfactory *locus*. Its collections have long been scattered through many different buildings. But out of the assembled material now brought together in the Museum halls of the Education Building, is to develop a series of scientific collections in the various departments of natural history

here pursued, that will be of effective instructional value entirely creditable to the State.

That a knowledge of a state's natural resources is of paramount moment to the people, needs no argument. That the people should have an insight into the larger scientific problems based upon and arising from these natural resources, will not admit of debate. In the natural and orderly development of practical and intellectual interest among the people, these are demands which have a superior force because they develop first.

But this great Commonwealth has certainly reached a stage of intellectual attainment where it may demand now, or should demand soon, the development of the fuller conception of the additional museums to which the statute has pointed the way. The State of New York has no museum of its own history. Whether it should have is not a matter for debate. The director's project for such a museum has been approved by the Commissioner of Education, by a special committee of the Board of Regents, by unanimous vote of the Board itself, by the finance committee of the Senate and by a thousand expressed opinions of competent citizens. Yet it does not exist. The substantial means fail largely because a *locus* for such a museum still fails. The hope that the Education Building might accommodate such a museum probably must be abandoned for want of room, and until there is a definite answer to the question " Where are you going to put it? " the appropriations necessary for its creation will be withheld. For such an historical museum public sentiment is ripe, and the time is ripe. In the impending amplification of the State's buildings provision should be made for it.

Have the people of the State of New York reached a stage of such intelligent concern in their past as to desire a portrayal of the development of the industries on which their wealth and happiness so largely depend? Has not the time arrived when a museum which would teach the people how the raw material in every line of industry is evolved into the finished product, would have a very distinctive usefulness to all the people? How many among the ten million citizens of New York know that their morning newspaper requires in its manufacture the use of sulfur and lime, and talc or clay as well as wood? One who is concerned with modern methods of any manufacture will be as much concerned in the historical development of that industry. Here lies an immense field of deepest concern and very high instructional value. To such an inspiring institution as a museum of industry, all paths would lead; the direct

appeal to the people would be of tremendous force and the response from the people would not fail to be substantial. It is well worth while to consider if the development of this conception in the museum series can wisely be left to a coming generation.

The public art museum is naturally the last to take its place in the development of the public museum idea. Time will bring it to every state as intellectual appreciation and the love of the beautiful advance. Experience has taught this, and the abundance of art museums maintained in the older countries by state grants is evidence that, even though the time may still be unripe in New York, at least its seed has taken root.

A law in which the people have intimated a desire, if not an intention, to develop the museum idea for the State on the broad lines indicated, remains but partially enforced. An intelligent people opened the door for the development of this idea; the conception has been rather too long left unheeded. This State has intimated its willingness to stand for the progressive habilitation of this conception and with the Regents of the University, charged with the enforcement of this law and the right to execute its intentions, lies here an opportunity for additional public service.

II

THE EDUCATIONAL FUNCTION OF THE STATE MUSEUM OF SCIENCE

In rendering the annual account of the procedure in this division during the fiscal year, it seems well to ask special attention from those who may read this report to the requirements of the real educational functions of this organization. Year after year record has been made of the advance of work along the several lines of scientific inquiry and conversation legitimately pursued by it. Data of scientific worth and moment have annually heaped up on the vast accumulation of like facts which the many years of previous work have brought forth; publications have issued in unbroken streams, in which some part of this accumulation of knowledge has been digested and set forth so as to take its proper place in the fabric of science. All the work done and the work begun, whatever its outcome, is to have its final bearing on the progress of the knowledge of this State and its natural resources, howsoever remote its immediate relation thereto may seem.

Not for an instant has the attitude of the chief educational officer, judicially reflecting the underlying sentiment of the State, intimated a purpose to restrain or curtail investigations in those lines of pure and applied science here carried on; on the contrary this influence has substantially favored and appreciatively encouraged all this work, in geology, paleontology, mineralogy, botany, entomology, zoology and archeology; the proper fields of science which this division covers. Such indeed has been the historic attitude of the State toward this work and such without question it is likely to be.

This Division of Science, during its long existence of seventy-five years, has rolled up a monumental record of the varied scientific resources of the State, embodying facts and factors which have modified and added to the total body of science in ways that it would now be difficult to estimate. The State of New York has become classic ground of these scientific branches and its fund of records is in keeping with the vastness of its natural wealth. There could be no justification for any cessation in these activities, whether they pertain to pure or to applied science. The mining production of this State has increased by 3000 per cent since the inception of the Geological Survey. The control of insect depredations upon the agricultural and forest crops of the State becomes annually of greater moment to the people with the yearly enlargement of the crops themselves. The conservation of all our native fauna and flora is a problem of growing concern.

These are but items in the progress of results, but it may be said with security that never in its history has this division been of more immediate usefulness to the progress of the people nor its contributions in pure science of more moment to the philosophy of life. The solution of every problem of science brings with it new and larger problems. The bell never rings on scientific progress and research — if it does, in a State like this, it is a knell that tolls for death and decay. There lie before us today in these various fields of research larger problems, more deeply fraught with the welfare of the Commonwealth, more intimately concerned with the inspiration and uplift of the citizen, than there have ever been.

But in an evident and pregnant sense we have now come to a turn in the road. This division is, and has long and properly been, a part in the University of the State and the Department

of Education; and as such its ideals of research have never faltered or been contravened. Now, by virtue of the equipment for it of extensive museum halls, it enters by force and by preference into more immediate and direct touch with the citizens. The burden is laid upon it to bring home to the people, by visual appeal, the meaning of all that has been said and done in science during the years past. The "State Museum" has long been a statutory designation, intimating scientific collections brought together for the exposition of our natural resources but in reality implying and covering the investigations of these resources themselves. At no time in the history of the organization has there been an adequate museum; not once in all its career have the people been able to come into actual touch with the materials on which the published scientific works have been founded or to learn through their own eyes the real meaning of the resources and of the operations of nature which have been portrayed on the thousands of pages and plates of our public reports.

The fact that this time has now arrived, that capacious quarters are about to be fully equipped for the reception of the material objects of science, brings, in effect, a new function to this division — that of making an efficacious and impressive contribution to the education of the people into these sources of knowledge, in a building devoted throughout to the official diffusion of knowledge.

There are certain aspects of this new function that are proper in this public report at a time when the equipment of this museum of science lies just a step ahead. The first of these, first in significance to those on whom this large duty devolves, is the fact that thus far the Museum has been the repository of the materials brought together by men engaged in the solution of scientific problems; these materials are not in any large sense conspicuous objects, carefully selected for special purposes of display, or to tell their own story. The collections of the Museum are very large, as state museums go, but if this large amount of material now contained in thousands of boxes, drawers and cases, were to be so divided that one part should comprise all that would arouse the interests of the inexpert, the latter would be but a slender fraction of the whole.

In the science of paleontology, a science of which the State of New York has for years been the especial patron, this fact is preeminently true. The Museum resources herein are large, but of this large accumulation there is only a small part that can be

made to tell its fascinating story to the uninitiated. To consider for a moment the demands of this science alone, and its place in a museum: the people of the State have a right to know what it is all about and why such extraordinary encouragement has been given to its prosecution; how it is that the State of New York has acquired its repute as the exponent of this science, and, if it is true that more is known of the paleontology of this State than of any equal area of the world (as has been said by a distinguished French geologist), where is the proof of this outside of published documents. There are no mysteries in science and the fruits of this knowledge are the property of the people who have paid for it. There is thus laid upon this division the acquisition of materials in this field of science, that will tell the story of the life in the seas and on the lands of ancient New York, its beginning, its development and its outcome, and tell it in a way so lucid and intelligible that the visitor to the Museum can read it and learn it. No good thing, therefore, that can make clearer the wonderful history of life in this part of our ancient earth, and so help to enforce the broader lessons of the life from which we have derived our own existence, can be sacrificed or neglected, for so simply gross a reason as that appropriations for this work are inadequate. A scientific specimen in a labratory and such a specimen in a museum are of two vastly unlike qualities. The one tells its story to the expert, the other must be made to tell its simple and clear story to the larger world.

What has thus been intimated with reference to this science of paleontology may be said with equal appropriateness of all cognate sciences. Each has its meaning as a factor in the education of all the people.

It is to this factor that the State Museum must now address itself. In so doing, to effect the real educational purpose of this Museum, to bring into sympathetic play with the scientific purpose of the organization the natural interests of the people in the works of nature, to meet this enlarged opportunity for service, substantial aid must be afforded.

A half million citizens of this State visit the seat of government every year, some on business and some on pleasure, and the capital, among its other attractions, is now to present to them a public museum — the museum of the people themselves. It is needless to speculate as to what percentage of visitors will direct their footsteps to this place. It is not the purpose of the

administration of the State Museum to offer to the visiting public a show of "curios," or a series of discrete and incongruous objects without rationale or consecuity. It is its purpose to bring through the public eye into the public heart the concerns of the natural resources of the State; the stories they tell, the business they record, the possibilities of commercial development they carry, the welfare and protection of the life that constitutes our native fauna and flora; to portray the development of the State from the beginning of its geography and with it to depict the course of its life through prehistoric stages up to the day of our aborigines with their multifold activities and culture; and so into the border lands of actual history.

Enough has been intimated in the foregoing in regard to the educational purpose of the State Museum of Science to make way for the conclusion that such functions can not be realized without a liberal support from an intelligent community. The State of New York can make what it will of its Museum — a storehouse of scientifically important but educationally arid facts, or a conservatory of inspiring and uplifting knowledge of its natural resources. To elect the latter as a deliberate policy of the Education Department is of necessity to supply the Education Department with the requisite funds to do it. It is in all respects a question of funds, for neither competent and enthusiastic men nor adequate materials are wanting for such an end.

It is therefore most proper at this juncture in the history of the organization to direct public attention to these requirements if the real purpose of the State Museum is to be assured.

Though it has been the practice of the State heretofore to encourage these several lines of scientific research, it has not been its practice to give hearty support to the development of its Museum. The State Museum as a depository of natural resources has been rather tolerated than espoused. Its collections have come to it incidental to other activities rather than purposely and for definite educational ends. The State Museum does not compete with the great civic but privately supported museums of this country and this day. Its field is not the world, but the State of New York. It should not attempt to exploit the world for its materials or for its educational purposes, but it should exploit the State of New York to its utmost, in order to set before the citizens of the State a conception of its natural resources and of the large scientific problems arising with them.

Conceding that its field is wisely restricted to the boundaries of the State, the State Museum should certainly have just as generous and substantial aid as is so freely given today to the private museum by the private patron. It is not enough for New York merely to recognize the fact that the State Museum exists simply because other states have created and recognize their museums. Nothing is enough for the proper pride of the State and its citizens except that this Museum shall be of the best and an effective arm of the educational service. It is not enough that the State Museum shall attempt to exercise its proper function with only the materials which may properly be designated as the accessories of its scientific researches. Nothing less than the best the State has is good enough for its people, and to permit this Museum to impart its instruction with less than the best, is to affront the people. The Museum of the people of this State should be of such quality as will bring credit to a State which has established a pioneer record for effective scientific research.

An illustration here is in point and immediate. The reportrayal of the life and culture of our aborigines, the Iroquois Confederacy, is one of the living functions of the Museum. In the Capitol fire a large part of the historic Indian collections were destroyed, some ten thousand specimens. The loss must be made good, so far as it is possible to do it. Time quickly wipes out records of the past. The Indian relics which were so common and perhaps so little valued in our boyhood are becoming scarce. The Iroquois Confederacy belonged to the State of New York and is a momentous factor in its history; it stood between the French and English cultures on this continent and kept the United States and Canada from becoming colonies of France. Every relic of this ancient culture now left among the citizens or in the soil should become the property of the State and that too as quickly as possible. These relics are records as valuable as books, and the generations to follow us will justly pass condemnation if we allow them to pass into obscurity and forgetfulness.

Moreover the State Museum should be recognized as the State's single and proper depository of scientific natural objects. The people should understand that here is where they may come for all information upon the natural products of the State. It is bootless and confusing for the State to maintain a collection of scientific objects in Letchworth Park on the Genesee

river, a few casefuls of birds and fishes in connection with one administrative department, and perchance of seeds and soils with another. Museums require today a high grade of technical service for the proper conservation of these materials. Such minor side efforts soon degenerate from lack of proper and intelligent care and involve an expenditure of public money for no good purpose.

Notwithstanding the support which has long been given to the work of the State Museum, its light has been too much under a bushel, it has had too much of the closet, has been too esoteric perhaps in its indifference to public appreciation. Its influence should reach to all the people. Yet it is well to record here the fact that a long and distinguished body of citizens have personally given their indorsement and support to its work; as witness the five hundred members of the New York State Museum Association, men of influence and distinction in all sections of the State.

III

CONDITION OF THE SCIENTIFIC COLLECTIONS

During the fiscal year some part of the usual field operations of the staff of the Science Division has been curtailed in order to meet the additional expense thrust upon the division by the operations preliminary to removal of the scientific materials to their new quarters. At the date of this report actual removal has not commenced but lies in the immediate future and the actual condition of the collections is now such that their transportation can be effected without delay or damage. Further than this, it has seemed wise to utilize the opportunity and some part of the available financial resources of the Museum to prepare and complete special objects and groups of objects of conspicuous worth and interest for prompt and ready display. These preliminary preparations have not been inexpensive. They have involved the dismembering and packing of large skeletons such as the whale, the mastodon, the elephant, the Irish elk and the entire series of lesser skeletons which could not be transported in their mounted condition. They have further involved the preparation of series of large models in plaster of especially noteworthy objects; and very particular packing of the State's extensive collection of birds and so on through the more delicate materials pertaining to the Museum. Provision has been made by

the Legislature for the construction of cases for all the Museum collections on specifications which will make them of most modern type. This fine equipment will permit the Museum to leave behind it the antiquated and uninviting cases which pertain to its past career. The planning for this equipment has involved close and arduous study and has called for the continued attention of the members of the staff.

Notwithstanding these immediate internal duties of the division the lines of scientific research which properly pertain to it have been forwarded along their usual channels. The subjects which have engrossed the attention of the members of the staff have been somewhat diverse in character. The mineral springs at Saratoga have been the subject of close investigation as to their origin and an elaborate report thereupon has been issued. The study of the geographical development of the State has reached a point at which it has been possible to issue during the year a series of maps indicating the condition of New York at various stages during the period of retreat of the great ice sheet. The mineral industry of the State has received special attention and lines of possible future development of this industry have been indicated in the annual report on the mining and quarry industry. It is a part of the business of the State Geologist to execute a geological map of the State and this work has been in progress for a number of years, the base of the map being on a scale of one mile to the inch. This work has made a decided advance during the last year and the area of the State covered in this very great detail now approaches 20,000 square miles. Probably in no state has the plotting of its geology been carried on so minutely over so large an area. Of special interest also has been the work of the State Entomologist in his efforts to control the depredation of the many insect pests that are damaging the agricultural and native forest crops of the State. In this line this official has been very diligently occupied and with advantageous results.

IV

REPORT ON THE GEOLOGICAL SURVEY

AREAL GEOLOGY

In recent reports, statements have been made in regard to the progress of the areal mapping of the State on the topographic base map. During the past year, the additional quadrangles completed in western New York are those of Brockport, Hamlin,

Albion and Oak Orchard. Preliminary control has also been made in the Medina and Ridgeway quadrangles. Reports with maps have been rendered in final form on the following quadrangles: Attica, Depew, Caledonia, Batavia, Eden, Silver Creek; the Phelps quadrangle is also essentially complete.

For this entire western New York region the present condition of the areal survey for the geologic map may be thus summarized:

Quadrangles published:

Auburn	Honeoye	Penn Yan
Buffalo	Naples	Portage
Canandaigua	Nunda	Tully
Elmira	Olean	Watkins
Genoa	Ontario Beach	Wayland
Hammondsport	Ovid	

Quadrangles reported:

Albion	Caledonia	Oak Orchard
Attica	Depew	Phelps
Batavia	Eden	Silver Creek
Brockport	Hamlin	

Quadrangles mapped:

Cherry Creek	Dunkirk	Westfield

Quadrangles begun:

Bath	Medina	Ridgeway

In northern New York a completed report on the North Creek quadrangle awaits publication. In the last field season, the Lake Pleasant quadrangle was surveyed by W. J. Miller, who reports that the prevailing rocks belong to the syenite-granite series and comprise syenite (augitic to hornblendic), granitic syenite, granite and porphyry. These rocks show all sorts of gradations from one type to another. Grenville gneisses, in areas sufficiently free from igneous rocks to permit separate mapping, are present in very subordinate amount. Grenville limestone is unusually scarce, only a few small outcrops having been noted.

Still other areas, often of considerable size, are made up of very closely involved syenite or granite and Grenville. Many

times the evidence seems conclusive that Grenville gneisses have been melted and actually assimilated by the molten intrusions so that various rocks of intermediate character have resulted.

Only a few diabase and gabbro dikes have been found. Several of the diabase dikes are distinctly porphyritic with large plagioclase crystals, but the exact nature of these rocks has not yet been determined.

The chief geologic interest of the quadrangle centers about the valley at Wells because of the location there of the important outlier of Paleozoic rocks comprising Potsdam sandstone, Theresa passage beds, Little Falls dolomite, Black River (Lowville) limestone, Trenton limestone, and Canajoharie (Trenton) black shale. Altogether the thickness of these strata is about five hundred feet and their areal extent about three square miles. The valley is of the nature of a fault basin with distinct faults along the eastern and western sides and a minor one between. Along the western side of the outlier the displacement of the fault is no less than 2000 feet, the Canajoharie shales showing a decided updrag effect near the fault. A very careful survey of the vicinity of Wells has been made resulting in the first detailed areal map (with structure sections) of this the most interesting Paleozoic rock outlier in the Adirondacks.

Another feature of special interest is the discovery of an outlier of Paleozoic rock in the Sacandaga valley from one to two miles above Hope post office. The only strata visible are considerable ledges of Little Falls dolomite and a little of the Theresa passage beds and Black River limestone. These strata are sharply downfaulted at least 1200 feet against the steep mountain on the western side of the valley. A minor fault appears to bound this outlier on the east so that this too seems to be a fault basin.

The major topographic features of the quadrangle are largely determined by normal faults, most of which strike northeast-southwest, though certain important cross faults also occur. There are many good examples of fault blocks, ridges and basins.

Glacial striae show the movement of the great ice sheet to have been southward to southwestward. There are several fine examples of extinct glacial lakes, especially those in the valley at Wells; along the Sacandaga river between the mouth of the

West Branch and Northville; and in the valley of the West Branch in the vicinity of Whitehouse.

During the year we have issued a bulletin on the *Mineral Springs of Saratoga,* prepared by James F. Kemp, in connection with the series of investigations of the Saratoga district which have been in progress for several years. The region here concerned is covered by the Saratoga and Schuylerville quadrangles and the rock geology, especially intricate in the latter quadrangle, has now been finally mapped by Doctors Cushing and Ruedemann. Features of special importance in the Schuylerville region are the great overthrusts and overturned folds in the Bald mountain district and the problem presented by the Schuylerville volcanic plug penetrating the Paleozoic slates. The latter has been much debated. The shales about the volcanic mass have been distinctly overthrust and it seems very evident that the eruptive has been involved in this movement. There are reasons for regarding the plug as of Postpaleozoic age and as thrust by lateral shove many miles westward of its original position.

The investigation of the structure of the shale belt of the Schuylerville and Saratoga sheets has led to the inference that the mineral waters of Saratoga fill a wide basin below the shale formed by the Potsdam sandstone and overlying Cambric and Ordovicic limestones and that the water of the Saratoga springs is derived by filtration through mountain folds about the Hudson river and carried westward under the thick cover of the Canajoharie shales to the Saratoga-Mount McGregor fault and its branches, where it finds the thinnest cover of shale and thus escapes. The Canajoharie shale rapidly thickens southward on account of its dip, and the projecting fault blocks of Precambric rocks close the basin to the northward.

Outside of this immediate region, the work in the shale belt has further brought out the fact that the thick formation of the Normanskill shale comprises two divisions, a lower one corresponding to the Chazy, and an upper, corresponding to the Lowville–Black river interval. Normanskill shale graptolites were found in shale intercalated in the grit beds extending many miles along the Hudson about Hyde Park, N. Y., indicating that the shale belt there may be largely of Normanskill age. The broad belt of rocks extending from Schodack Landing to Stockport has hitherto been entered as Georgian on the State map, but the larger middle part of this is now known to consist of Deepkill

shales, such characteristic graptolites as Didymograptus nitidus and Goniograptus thureaui having been found in railroad cuts below Stuyvesant.

In southeastern New York the complex problems involved in the *Tarrytown* quadrangle have received attention from Dr Charles P. Berkey who has been aided in his interpretations by his extensive knowledge of the underground rock structure in the course of the Catskill aqueduct.

The *Clove* quadrangle involving an area of Precambric and highly altered Paleozoic rocks east of Poughkeepsie has been studied by Prof. C. E. Gordon and for the most part mapped. The gneisses of the Highlands extend northward as a huge spur in the southeastern part of the quadrangle, and on the west and northwest are overlain by and faulted with the lower Cambric quartzite which in turn is faulted with the Fishkill limestone. Both quartzite and limestone continue northeastward from the Poughkeepsie quadrangle and all three associated formations present essentially the same relations in both areas.

At Poughquag, in the town of Beekman, is the type locality of the basal quartzite of southeastern New York and while fossils have not yet been found in it, the structural relations clearly demonstrate its identity with the rock yielding Olenellus at Johnsville in the town of East Fishkill. The basal quartzite ends against the schist of West Pawling mountain about two miles northeast of Poughquag. Between Poughquag and this point, what appears to be the northern margin of the quartzite forms " Garden Hollow." The drift is very heavy along the northern margin of the Highland spur, forming an exceptionally fine drumlin topography near Stormville, Green Haven and Poughquag. Northeast of the last village, it greatly obscures the relationships of quartzite, limestone and schist.

The northern boundary of the Fishkill limestone followed east from the Poughkeepsie area for a short distance presents the same serrated character, a short toothlike spur appearing just north of Sylvan lake. It then continues as a long narrow tongue-like spur eight or ten miles north of Poughquag in the valley of Fishkill creek and forms what is known as the " Clove." In tracing the eastern boundary of the limestone with the schist, a fine example of coarse fault brecciation was noted a mile and a half north of the hamlet of Clove indicating the character of the contact.

On the east the gneissic spur is overlain by schist which west of Pawling forms what is known as " West Pawling mountain " and farther north between the " Clove " and the Dover valley forms " Chestnut ridge." This garnetiferous mica schist, at places showing well-developed crystals of cyanite, is regarded as the metamorphosed derivative of the " Hudson river " slates. West of the " Clove" it grades into grits, phyllites and slates.

At Whaley pond is a patch of limestone known as the " white ledge " which is quite isolated from any other limestone outcrops. It is overlain by a quartzite, very similar to the basal quartzite and while clearly lying against the gneiss at places, apparently grades upward into the schist and appears to be a member of that formation. The relations of gneiss and schist along the eastern margin of the spur are still obscure.

Extending from the southern to the northern boundary of the quadrangle through the townships of Patterson, Pawling and Dover is the Dover-Pawling limestone valley. This has been mapped as far north as Wingdale. The eastern and western margins of the valley are irregular and in many places show a confusion of schist and limestone patches of varying sizes in juxtaposition and in such further relation as to suggest that they are dismembered portions caused by disturbances from beneath. Two miles north of Pawling at " Corbin hill " is a large patch of gneiss which is believed to be an inlier of the Precambric rocks; a broken piece of the Precambric floor thrust up among the younger rocks. It is bounded on the east, south and west by limestone and on the north by schist, and the field relations, as thus far studied, favor the view that all the contracts are faulted. The northwestern slope of the hill is heavily drift-covered.

East of the Dover-Pawling valley, as far north as Wingdale, the schist rises as a high mass of passes eastward into Connecticut.

SURFICIAL GEOLOGY

In continuation of his previous observations, work was carried on by Prof. H. L. Fairchild in the Hudson-Champlain valley.

In the report for 1911 (Museum Bulletin 158, pages 32–35), the hypothetical glacial Lake Vermont of Woodworth (Museum Bulletin 84) was provisionally accepted, and some high level shore features about Covey hill and in the St Lawrence valley were correlated with it. Some yet higher beach phenomena

were attributed to glacial waters held up to the level of the Altona spillways, and these waters were called Lake Emmons.

Further study of the problem led to serious doubt of the correctness of these views concerning the ancient waters of the Champlain valley, and specially of the nature of the so-called Vermont waters, and it became necessary to reexamine the phenomena.

Under the theory holding the Vermont waters as glacial the summit plane of the marine waters was thought to be represented by the top of the series of heavy cobble bars about Covey hill, with an altitude of 525 feet. The shore features above this level were attributed to glacial lake waters. This view was accepted by Professor Goldthwait, who was studying the marine plane in the lower St Lawrence valley for the Canadian Survey.

Several considerations, specially the amount of land uplift in the district indicated by the Iroquois outlets, induced the belief that the Covey hill cobble ridges did not represent the highest stand of the oceanic waters, and that the " Lake Vermont " features (about 650 feet at Covey hill) were also produced by sea-level waters. At the beginning of the summer's work in 1912 a field conference was held with Professor Goldthwait and the features on a part of the Mooers quadrangle were reviewed. The beach phenomena between the Covey hill bars and the Vermont plane are very weak in that district. The lack of definite shore features above the summit plane of the Covey hill bars, 525 feet, is in strong contrast with the heavy development below that plane. The results of the conference were unfavorable to the view that the land surface above the Covey hill plane had been slowly raised out of the sea-level waters, like the slopes below that plane.

Immediately following the conference an examination was made of the phenomena on the territory south of the Mooers quadrangle, the newly surveyed Dannemora quadrangle, taking advantage of an advance copy of the unpublished Dannemora sheet. A very unexpected and surprising display of shore features was discovered. It was found that south of the Mooers quadrangle the Covey hill shore features are almost wanting, being replaced in the vertical position by a deluge of sand. But ranging above the Covey hill plane is a remarkable development of beach and delta features, reaching up to 700 feet. The strongest display of the cobble bars represents the " Vermont " plane, here

from 500 to 600 feet, and they extend practically throughout the whole length of the Dannemora quadrangle. It is evident that these beaches correlate with the Cobblestone hill bars and other detached features on the Mooers quadrangle that formerly were puzzling.

Being specially developed in the town of Peru these bars in the "Vermont" plane will be called in this report the Peru beaches. This shore exhibits all the characters which argue for the marine origin of the Covey hill beaches. Taken in connection with the features on the adjacent Mooers quadrangle they afford an excellent illustration of the lack of value of negative evidence in study of shore lines, and the error in judging confidently from a single district or a limited area.

The Peru ("Vermont") shore phenomena are found to be well developed southward throughout the Champlain valley, on both sides of the valley, and to lie far above the Fort Edward divide. They have been mapped on the Vermont side at Burlington, Middlebury and Brandon. The plane declines from 700 feet on the international boundary to 660 feet at Cobblestone hill, 520 feet near Ticonderoga, 440 feet near Glens Falls, and 390 feet near Mechanicville. The slope of the plane is a little over two feet a mile. These beaches are not the highest or summit bars of the region but were formed after some uplifting of the land had taken place. Their strength suggests that they represent a relative pause or a slower rate in the land uplifting.

The highest well-developed bars found on the Dannemora quadrangle are 706 feet in height, and lie west of Peru village. Behind the highest shore features throughout the quadrangle lie glacial drainage channels, terminating in deltas. These channels and deltas definitely determine the height of the standing waters during the recession of the ice front. This altitude on the Dannemora quadrangle was over 700 feet.

Northward the summit plane of the Champlain waters during the time when the ice sheet was waning is represented by beaches at Shea's Lines, on the Canadian boundary, south of Covey Hill post office, at about 750 feet; and also by the series of good bars at Cannon Corners, with an altitude of 750 feet. Southward the summit of the standing water is shown in various localities and specially at Port Henry. In the Hudson valley it is well shown. It is found that many cities and villages on both sides of the valley are located on broad summit plains of deltas

that were built in the marine waters that occupied the valley as the ice gave way. This water plane rises from zero in the vicinity of New York to at least 350 feet at Schenectady, or at the rate of 2.2 feet a mile.

The practical continuity and correspondence in level of the highest water plane on both sides of the Hudson-Champlain valley proves that the waters filled the entire breadth of the valley and that the shore phenomena are not the product of ice-border lakes. It also appears that the waters were not held up by any moraine dam or any barrier of land uplift.

Over the Fort Edward divide the waters were more than 300 feet deep, and all the phenomena in the Fort Edward-Schuylerville district are those of static waters, slowly lowering and terracing the copious detrital deposits on both sides of the valley. There is found no evidence of any glacial stream flow below the summit water plane.

As the ice front melted back the ocean followed it and flooded the valley. The waters were at first the Hudson inlet; later the Hudson-Champlain inlet; and finally the Hudson-Champlain strait.

The minimum amount of continental uplift on the Canadian boundary is approximately determined by the deformation of the Iroquois plane. In the former report (page 32) it was shown that if we assume the Covey gulf outlet of Lake Iroquois to have been no lower than the original Rome outlet, then the district must have been lifted at least 665 feet. This makes the Covey hill bars 140 feet below the marine summit. The total uplift must have been as much more than 665 feet as the gulf outlet was beneath the plane of the Rome outlet. The study of the high-level shore phenomena leads to the confident belief that the Covey hill district has been uplifted at least 750 feet since the ocean waters displaced the ice sheet. This would carry the gulf channel only 85 feet beneath the Rome outlet.

Summary. Heavy and conspicuous static water phenomena occur with practical continuity on both sides of the Hudson-Champlain valley from New York City to Canada, rising steadily from zero at New York to 750 feet at the north edge of the State. Above this plane the land is cut by glacial drainage. All the facts now known and the relationship of the beaches to the topography of the valley walls indicate that the waters were confluent with the ocean. The absence of marine fossils in the

higher deposits is probably chiefly due to the freshening of the water in the narrow inlet and strait by the very copious glacial waters.

INDUSTRIAL GEOLOGY

General review. The work in industrial geology which is directed chiefly to the investigation and description of the State's mineral resources has been carried forward actively during the past year. The annual summary of the local mining field, prepared in the form of a report for the general guidance of those engaged in the industry or otherwise interested in its current progress, has been continued, and the latest issue brings the information down to the close of 1911. Besides complete production statistics, the report contains notes and short articles dealing with the present sources of supply of the valuable minerals and the more interesting features involved in their exploitations. In the year 1911, conditions on the whole were rather unfavorable to mining and quarry operations; very few branches were able to report progress in terms of increased output. The aggregate valuation of $31,573,111 for the crude products was less by about 10 per cent than the total returned in the preceding year. The iron mining industry showed the full effects of the depression, as it is always very responsive to economic changes. The clay-working and quarry industries, especially the departments engaged in the production of building materials, were likewise much depressed. The setback had no serious consequences so far as concerns the permanent welfare of the industries, and it is expected that the record for 1912 will show some improvement, if not material gains, in many branches.

Talc. A sketch of the talc deposits of St Lawrence county and the present status of their industrial development has been prepared to meet the public inquiry for information on the subject. Some interesting developments have taken place during the last year or two, and it is hoped that with the preparation of large-scale topographic maps, a work now in progress, the opportunity will soon be forthcoming for a comprehensive account of the geology and economic features of the district. Since commercial operations were started, a little over thirty years ago, the mines have contributed nearly a million and a half tons, all of which required mechanical preparation before shipment to market. There is no other district in this country where the mining and milling of talc is carried on on so large a scale. The occurrence of metallic ores, including zinc blende, pyrite and hematite, in close proximity with

the talc and in the same geological surroundings, is a noteworthy feature which has only recently attracted attention. The ores form pockets and bands in limestones and schist with the characteristics of replacement deposits. In any case, they have undoubtedly been introduced in solution and precipitated in their present place after the upraising of the sediments represented by the wall rocks. It would appear probable from these and from other considerations which need not be entered upon here that there is a close genetic relation between the talc and the metallic minerals. This point is of some significance in regard to the probable extent of the talc deposits and renders a more detailed investigation of the field highly desirable.

Zinc. A brief visit to the zinc ore localities of St Lawrence county was made during the summer for the purpose of studying the occurrences and securing material for the collections. There has been much activity in prospecting within the district, but the recent developments have been restricted, as in the previous year, to the locality near Edwards. As the result of recent discoveries, it is known that zinc blende has a rather wide distribution in the section from Edwards to Sylvia lake, which is practically coextensive with the talc district. The economic importance of the deposits is scarcely to be estimated as yet, but the work on the single property that is under exploration, lends encouragement to the hope that a substantial industry may be developed. Some difficulty has been encountered in the mill treatment of the ore which contains more or less pyrite in intimate association with the blende, the two minerals occurring usually in finely divided intergrown particles.

Field observations show that the blende is found in crystalline limestones of the same belt that includes the talc and tremolite beds. The limestone belt is interrupted here and there by bands of rusty, quartzose schists, and by dark basic hornblende and biotite gneisses. The rusty schists are very certainly a part of the same sedimentary series representing probably old sandstones, while the hornblende and biotite gneisses also are believed to be derived from sediments of the nature of shales, though in places they may represent altered igneous intrusions of gabbroic nature. The gneisses and schists have been invaded by a red granitic rock, with pegmatitic phases, that is developed in dikes, bands and occasionally as bosses of some size. The granite is perhaps related to the great batholiths of that rock which are found in the interior of the Adirondacks. The gneisses have been so injected and soaked by the granite that in places they partake quite as much of igneous as of gneissic

character, in fact, all gradations from the one rock to the other may be found.

The limestones and schists have a northeasterly strike and are upturned at a high angle. The limestones of this section carry abundant impurities, though elsewhere the same series may be nearly free from admixture. The principal foreign minerals are silicates, most commonly tremolite, serpentine and talc. They are either scattered in small aggregates, or they form nodules, bands and veinlike bodies of practically solid silicates. The limestones are magnesian and in the vicinity of the ore bodies show the effects of solution and decomposition by ground waters. The circulation of water has been facilitated apparently by the broken, shattered nature of the rock which has undergone severe compression and more or less differential movement. The process of dolomitization and silication has preceded for the most part the introduction of the ores, but it may have resulted from the same agency, that is by the transporting of silica and magnesia held in solution in meteoric or deep-seated waters.

The zinc blende occurs in lenses and bands and also as scattered particles within the limestone. The deposits have the appearance of replacement bodies rather than the fillings of open fissures or cavities. In most places, the borders of the richer bands are not sharply defined, but are in the nature of transition zones which shade off gradually into the limestone. The internal structures are not those characteristic of open-fissure fillings as there is no appearance of crustification or of drusy cavities lined with crystallized minerals. The compact granular nature of the ore furthermore suggests deposition at considerable depth and under pressure.

The recent development work at Edwards has disclosed some interesting features in regard to the deposition of the ores which are the subject of current study. The problem as to the derivation of the ores seems to be interrelated with the partial silication of the limestones which has led to the formation, in the first place, of tremolite. This mineral has changed over to talc, more or less completely, through normal weathering or, which appears more likely, as the result of decomposition brought about by the later stages of the underground circulations that deposited the ores. The serpentine in larger part, however, seems to have formed directly, that is deposited as such from solution and not originating as an alteration product of an anhydrous mineral. Some of the serpentine is certainly later than the metallic minerals, as shown by the veins and stripes of the colloidal variety which intersect the ore.

There are rounded aggregates which may represent an earlier generation, perhaps derived from a silicate mineral of the pyroxene or hornblende family. The talc nodules are frequently bordered by veins of massive serpentine that appear to have resulted as a reaction from contact of the talc with iron-bearing solutions. The limestones at this place have undergone considerable disturbances from regional compression since the deposition of the ores, manifested by the brecciated and faulted condition of the deposits in certain places and the flowage of the limestones into the fractures so as to cement the broken and disjointed parts. The whole mineral association seems referable to the work of underground waters which in a period of long-continued circulation have introduced and deposited various ingredients. There is insufficient evidence, as yet, to connect the mineralization with igneous agencies, and if these have been a factor, they were no doubt connected with the granite invasion, the only intrusive that has any prominence in the district.

SEISMOLOGIC STATION

The year's records for the local seismologic station are given in the accompanying table in conformity with the plan previously used in reporting the data. The list, it may be noted, includes only such disturbances as set up prolonged and well-marked vibrational movements, usually differentiated into phases — such as are referable without much doubt to true tectonic shocks transmitted to the station from more or less remote origins. Of almost daily occurrence are brief or indistinct motions arising from various causes not wholly explained, but these have not been taken into account in the table.

The number of individual tracings of earthquakes obtained within the year ending September 30, 1912 was twelve, as compared with nine in the preceding period, and nineteen in the year 1909–10. This record seems to indicate a general falling off of late in seismic frequency, at least with respect to the heavier shocks which are recorded mainly at the Albany station. There have been at the same time few destructive disturbances; within the past year, none has transmitted vibrations that exceeded the capacity of the instrument for registration.

Since the station was established in March 1906, it has supplied data in regard to ninety-eight individual shocks. In view of the fact that the installation represents an early type, comparatively, the results may be considered quite satisfactory. They sufficiently demonstrate that the somewhat peculiar conditions existing in this

vicinity, particularly with respect to the heavy mantle of glacial sands and clays which cover the bedrock, are not incompatible with such service. The instruments belong to the lighter pattern of the horizontal pendulums and are not capable of a magnifying ratio of more than ten to one in the average run. They possess, however, the requisite sensitiveness for recording legibly the tremors of all heavy or damaging quakes throughout the seismic zones of this and other countries. There are in the local files tracings from such widely separated origins as California, Valparaiso, Kingston, the Himalayan region, Turkestan, Messina, Mexico, Costa Rica, Iceland, northern Alaska and Turkey in Europe. The smaller distant quakes, as well as the very slight jars from nearby sources, appear to be beyond the capacity of the instruments to register.

The general care of the instruments during the year has been assumed by Mr R. W. Jones. With their increasing age, they have required more attention to maintain them in working order, especially on account of their liability to rust. The station is very damp during the summer months and then they have to be frequently dismantled and thoroughly cleaned. As yet, no provision has been made for their removal to new quarters, and their maintenance in their present place will entail added labor for the future. In case a new station should be equipped near the present location of the Museum, it would appear advisable to instal one of the newer types of seismographs for registration of the smaller quakes, along with the present instruments which are well adapted to the registration of macroseisms.

RECORD OF EARTHQUAKES AT ALBANY STATION, OCTOBER 1, 1911 TO SEPTEMBER 30, 1912

Standard time

DATE	Beginning preliminaries	Beginning principal part	Maximum	End	Maximum amplitude
1911	H M	H M	H M	H M	mm
December 16	2 20½ P. M.	2 36 P. M.	2 38 P. M.	3 30 P. M.	15
1912					
January 31	3 20 P. M.	3 35½ P. M.	3 36 P. M.	4 25 P. M.	10
March 11	....	5 38½ A. M.	5 39 A. M.	6 00 A. M.	3
May 6	2 06½ P. M.	2 19 P. M.	2 20½ P. M.	3 20 P. M.	7
May 22	9 50½ P. M.	10 18 P. M.	10 22 P. M.	11 00 P. M.	4
June 7	5 56½ A. M.	....	....	6 17 A. M.	¼
June 7	7 41 A. M.	....	....	8 35 A. M.	¼
June 7	1 40 P. M.	....	....	2 30 P. M.	1
June 8	2 46 A. M.	3 01¼ A. M.	3 05¼ A. M.	3 40 A. M.	10
June 10	11 15¼ A. M.	11 33¼ A. M.	11 38¼ A. M.	12 30 P. M.	8
June 12	7 49½ A. M.	....	7 59 A. M.	8 30 A. M.	½
July 8	4 57¼ P. M.	5 17¾ P. M.	5 18¼ P. M.	6 00 P. M.	8

December 16th. A clearly marked record of the earthquakes that shook the city of Mexico on this date. The phases are well differentiated and give a very close approximation of the distance to the source, about 3000 miles. The larger vibrations are exhibited on the north-south component. Although the record would indicate it to be one of the heaviest shocks of the year, it appears to have done little damage.

January 31st. A good tracing of the earthquake that was central near Valdez, Alaska, when it occurred at about 10.12 o'clock in the morning. The east-west component is the larger. The indicated distance to the source is about 3000 miles.

March 11th. The preliminary tremors are not shown on the record. The origin appears to have been relatively near, perhaps in the West Indies. The Harvard station estimated the distance at about 1000 miles.

May 6th. A second Mexican quake, felt in the city of Guadalajara. The record is fairly clear, but less strong than that of December 16th. The tremors traveled as far as Germany.

May 22d. The record of a long-distance microseism with a period of from 20 to 30 seconds. It is not clearly separated into phases. An earthquake was reported from the Hawaiian islands on this date.

June 7th. A series of probably related disturbances from a source between 3000 and 4000 miles away, but not definitely located. A volcanic outburst occurred in the Alaskan peninsula about this time.

June 8th. This probably marks the culmination of the series of shocks which began the preceding day. Besides the heavy disturbance, there were light tremors at intervals which were so broken up by interference as to permit no satisfactory readings. The more notable of these minor movements occurred between 4.10 and 4.30 a. m., 5.22 and 5.33 a. m., and 7.55 and 8.45 a. m.

June 10th. An untraced disturbance about 3500 miles away.

June 12th. Very faint record, apparently not connected with the tremors, felt in South Carolina and Georgia the same morning.

July 8th. A rather strong disturbance with the east-west wave motion more pronounced than the north-south. The estimated distance of the source is about 4000 miles. A heavy shock occurred at Fairbanks, Alaska, about this time.

PALEONTOLOGY

In the reports of several years past, reference has been made to the progress of a memoir on the fossil arachnids or Eurypterida

of New York. The work has now been completed and issued. It is the summation of many years of labor in the acquisition and study of this interesting extinct group of animals, which, by virtue of their abundance and variety in the rocks of New York, form one of the very striking features of its paleontology. This memoir is presented in two volumes, one of text and one of plates, the pages numbering 628 and the plates 88. A conception of the contents of the memoir is conveyed by its table of contents:

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In last year's report a brief notice was given of an extraordinary section of the Siluric rocks on the Bay of Chaleur, at Black Cape. Previous to this account, only very brief notice had been taken of this place in the geological reconnaissance of that region, but as this section proves to be one of the extraordinary developments of the Siluric system, attaining a thickness of deposition perhaps not elsewhere equaled, it seemed very desirable to have a more exact examination of it made. With the consent and substantial support of the director of the Geological Survey of Canada, C. A. Hartnagel of this staff was detailed to this work.

Black Cape lies on the north shore of the Bay of Chaleur, seventy miles east of Matapedia and directly east of the valleys of the Grand

and Little Cascapedia rivers. In the Siluric section the strata are nearly all calcareous with intercalations of red shale near the top. They stand at high angles to the horizon, usually dipping 60–80° s. e., but these dips vary somewhat, though without unconformities. The eroded edges of the strata are overlain elsewhere in the region by the red sands and conglomerates of the Bonaventure formation, and there are several considerable fissures in the Siluric limestones which are filled in with red sand derived from the overlying beds. All these occurrences indicate land exposure of the Siluric during all the early and middle Devonic time.

The base of the section at the west begins with greenish, highly nodular lime-shales, very compact and heavy bedded, weathering out into irregular and gnarled shapes. These alternate with more highly calcareous shales and compact limestones of red and ochreous tints. These compact limestones contain Stricklandinias of great size (S. gaspensis Billings) and in great number and with these are Spirifers of the S. radiatus-niagarensis type and occasional Whitfieldellas. Throughout the lower beds the rest of the fauna is largely of Stromatoporoids and corals which occur in enormous quantity and great diversity. There are Halysites of several species, having horizon values, Favosites and Alveolites of great size, Heliolites, Syringopora, Eridophyllum in extensive colonies, Zaphrentis and other cyathophylloids in considerable variety. Additional species in these lower beds are Calymmene, Chonetes, Atrypa reticularis (Siluric type), Tentaculites, cyclostomatous gastropods, etc.

At an elevation in the series of about 1500 feet, where the scraggy limestones continue, there is some indication of change in the fauna by the addition of brachiopods of the genus Camarotoechia, Rafinesquina, the cephalopods Orthoceras, Trochoceras, etc. From Howatson's (elevation on section, 1500 feet) on eastward the scraggy limestones continue as far as the breakwater. Then follows a heavy mass of sandy shale. This sedimentation continues sandy to near the end of the section which terminates at the volcanic mass forming Black cape, but toward the top the sands become interlaminated with thin beds of volcanic ash, with red and purplish shale and eventually calcareous and variegated beds succeed to these, becoming in places compact lime banks entirely constituted of the debris of fossils.

These sandstones and sandy shales are remarkably profuse in

corals, some of the species being palpably unlike those of the lower beds. Beyond the volcanic mass known as Black cape, there are several noteworthy inclusions of the fossil-bearing limestones within the lava.

So far as at present indicated by the fossils, this section from base to top is of the age of the Niagara (exclusive of Clinton) or Rochester shale of the interior Siluric, though the assemblage will doubtless show a preponderance of Atlantic or European types which will bring it into more proper comparison with the Gulf sections at Arisaig and on Anticosti island. Its thickness is not less than 7000 feet and in this respect the section overpasses any Siluric section known in America.

V

REPORT OF THE STATE BOTANIST

The plants collected during the season of 1911 have been mounted on herbarium sheets and arranged in their proper places in the herbarium or placed in boxes and distributed as far as possible in their proper places. Lack of room has prevented the completion of this work, but it is expected that removal to the Education Building will soon obviate this difficulty.

Specimens of plants, indigenous and naturalized, for representation of the species in the State herbarium have been collected in the counties of Albany, Essex, Lewis, Livingston, Monroe, Steuben and Sullivan.

Specimens have been contributed that were collected in the counties of Albany, Chautauqua, Cattaraugus, Clinton, Columbia, Fulton, Hamilton, Herkimer, Monroe, New York, Oneida, Ontario, Onondaga, Orleans, Oswego, Rensselaer, Richmond, Schoharie, Suffolk, Tompkins, Ulster, Warren and Washington.

Specimens of extralimital species have been contributed that were collected in Canada, California, Connecticut, Cuba, District of Columbia, Indiana, Kansas, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Montana, New Hampshire, New Jersey, North Carolina, Ohio, Pennsylvania, Utah and Vermont.

The number of species of which specimens have been added to the herbarium is 278 of which 72 were not before represented therein. Of these, 11 are considered new or hitherto undescribed species.

The number of those who have contributed specimens of plants is 70. This list includes the names of those who sent specimens for identification only, if the specimens were of such character and condition as to make them desirable additions to the herbarium. The number of identifications made is 1859; the number of those for whom they were made, 136.

Two species of mushrooms have been tried for their edible qualities, and though neither can be considered first class in all respects, both have been found to be harmless and palatable and have been approved as edible. Colored figures of them have been prepared and descriptions have been written. These make the whole number of New York species and varieties of mushrooms now known to be edible 215.

A small but attractive looking mushroom was discovered growing among decaying pine leaves in Richmond county by W. H. Ballou. He found it to be very poisonous. It is therefore figured and described as a poisonous fungus.

Specimens of seven species of Crataegus or thorn bushes have been added to the herbarium. Of this genus of trees and shrubs, 218 New York species are now recognized. Prof. C. S. Sargent, the eminent crataegologist, has kindly prepared a synoptical key to our New York species. This was a most difficult and intricate piece of work which none but an expert in this peculiar branch of botany could well do. In this work he has laid an excellent foundation for the study of these interesting though often considered nearly worthless and annoying shrubs and trees. He has added to this descriptions of 25 new species of this genus.

PLANTS ADDED TO THE HERBARIUM

New to the herbarium

Achillea ptarmica *L.*
Amanita ovoidea *Bull.*
Anellaria separata (*L.*) *Karst.*
Aposphaeria fibriseda (*C. & E.*)
Artemisia carruthii *Wood*
A. dracunculoides Pursh
A. glauca *Poll.*
Arthonia quintaria *Nyl.*
A. radiata (*Pers.*) *Th. Fr.*
Betula alba *L.*
Bolbitius vitellinus (*Pers.*) *Fr.*
Boletus retipes *B. & C.*
Calosphaeria myricae (*C. & E.*) *E. & E.*
Calvatia rubroflava (*Cragin*) *Morg.*
Chrysothamnus pinifolius *Greene*
Clavaria grandis *Pk.*
C. vermicularis *Scop.*
Cladochytrium alismatis *Büsgen*
Collema crispum *Borr.*
Collybia murina *Batsch*
Coronopus procumbens *Gilibert*
Crataegus gracilis *S.*
C. harryi *S.*

Crataegus leptopoda *S.*
C. livingstoniana *S.*
C. macera *S.*
C. procera *S.*
Creonectria ochroleuca (*Schw.*) *Seav.*
Diaporthe castaneti *Nits.*
Diatrypella favacea (*Fr.*) *Ces. & DeNot.*
Didymella asterinoides (*E. & E.*) *Rehm*
Dothidea baccharidis *Cke.*
Escholtzia californica *Cham.*
Flammula graveolens *Pk.*
Helicopsis punctata *Pk.*
Heliomyces pruinosipes *Pk.*
Helminthosporium fuscum *Fckl.*
Hydnum laevigatum *Sw.*
H. subcrinale *Pk.*
Hygrophorus ruber *Pk.*
Inocybe radiata *Pk.*
Lenzites trabea (*Pers.*) *Fr.*
Leptonia euchlora (*Lasch.*) *Fr.*
Macrophoma juniperina *Pk.*
Malus glaucescens *S.*
Mycena flavifolia *Pk.*
M. splendidipes *Pk.*
Opegrapha herpetica *Ach.*
Penicillium hypomycetes *Sacc.*
Pestalozzia truncata *Lev.*
Phialea anomala *Pk.*
Phoma asclepiadea *E. & E.*
P. semiimmersa *Sacc.*
Phyllosticta mahoniaecola *Pass.*
P. rhoicola *E. & E.*
Placodium camptidium *Tuck.*
Pleurotus tessulatus (*Bull.*) *Fr.*
Polyporus dryadeus (*Pers.*) *Fr.*
Puccinia urticae (*Schum.*) *Lagerh.*
Riccardia sinuata (*Dicks.*) *Limpr.*
Russula ballouii *Pk.*
Septoria margaritaceae *Pk.*
Silene dichotoma *Ehrh.*
Tricholoma latum *Pk.*
T. piperatum *Pk.*
T. subpulverulentum (*Pers.*)
Urophlyctis major *Schroet.*
Vermicularia hysteriiformis *Pk.*
Verrucaria muralis *Ach.*
V. papularis *Fr.*
Vicia hirsuta (L.) *S. F. Gray.*
Zygodesmus avellanus *Sacc.*

VI

REPORT OF THE STATE ENTOMOLOGIST

The State Entomologist reports that the past season was noteworthy because of the superabundance of the common *apple tent caterpillar* in the Hudson and Mohawk valleys and on the borders of the Adirondacks. The pests were so numerous that most of the wild cherries on the roadside were defoliated and many orchards severely injured. There were records of local damage here and there by the allied *forest tent caterpillar;* in several sections extended tracts were stripped of foliage. There is at least a fair probability of this insect being more abundant another season and possibly causing serious injury locally. The *green maple worm,* so numerous last year, attracted no attention the past season.

Petroleum compounds as insecticides. Dead and dying trees in several Greene county orchards which had been sprayed the preceding autumn with a commercial preparation of petroleum,

led the Entomologist to study carefully the cases and the behavior of the trees through the season. A comparison was also made between the condition of these trees and injury of earlier years following applications of petroleum. He was unable to note any material difference between the two and, furthermore, observed a marked restriction of the damage to trees or even portions of trees which had received the application. After a careful study of the various phases of the matter he was forced to conclude that a certain measure of risk attaches to the application of mineral oils or preparations of the same to trees in a dormant condition. This matter is discussed in detail in the Entomologist's report.

Fruit tree pests. The experiments conducted by the Entomologist during the last three years against the *codling moth* were continued in the orchard of Mr Thomas Albright, of New Baltimore, and very satisfactory returns obtained. The check or unsprayed tree produced only 38.95 per cent of sound fruit, while sprayed trees of the same variety, less than 100 feet away, yielded over 97 and in some instances more than 98 per cent of worm-free apples. The results of this experiment and those of earlier years were checked by a careful study of representative trees in the orchards of Messrs W. H. Hart, of Poughkeepsie, and Edward Van Alstyne, of Kinderhook. These latter were sprayed under strictly commercial conditions with no expectation at that time of their being subjected to a test later. The results in these commercial orchards were very gratifying. The northern spies belonging to Mr Hart produced an average of over 98 per cent of sound fruit, while the greenings and Baldwins on the Van Alstyne place gave an average of over 96 per cent of worm-free apples. The past four years' experiments go far to show that under normal crop conditions one thorough and timely spraying for the codling moth should result in producing from 95 to 98 per cent of sound fruit. These tests are of great practical value to the fruit grower, since they afford a reliable basis for correctly estimating the value of spray applications.

The *pear thrips,* a minute insect which blasted or nearly destroyed the pear crop in a few orchards in the Hudson valley, was studied with special reference to conditions favoring injury, and the efficacy of spraying with a tobacco preparation demonstrated. The insect, potentially a very dangerous form, is discussed

in the Entomologist's report. The work of the *pear midge* was investigated and a number of desirable photographs of the larva and its work secured.

Gipsy moth. The danger of injury by this notorious pest was emphasized by the discovery of a small colony, practically restricted to a city block, at Geneva. An examination of the locality showed that the infestation was probably of three or four years' standing. The chances are at least fair that the insect was introduced in that section with nursery stock, though no undoubted evidence as to the source of the infestation has been adduced. The discovery of similar colonies may be expected from time to time. For a period at least, no effort should be spared to exterminate such outlying infestations, since this policy is much cheaper and decidedly more advantageous to the general welfare than the adoption of repressive measures with the inevitable slow spread of the insect and the greatly increased cost of controlling the pest incident to its being distributed over an extended area. Such measures are also advisable, since checking the normal spread is most advantageous for the development of introduced parasites, a number of which have already been established in this country.

The recent enactment by Congress of a national plant quarantine act, recommended by the Entomologist and his associates in other states, is an important step in advance and should prove of great service in restricting the spread of this and other injurious insects as well as preventing the introduction of dangerous pests.

Brown-tail moth. This species has attracted comparatively little attention the past season, though owing to its having become established in the northwestern corner of Massachusetts, it is only a question of time before it will make its way into this State. The danger of this pest being introduced on nursery stock grown in infested sections still exists and should not be overlooked simply because a portion of the State is contiguous to infested territory. The winter nests are so characteristic that there should be little difficulty in identifying the insect and at the outset prevent its becoming excessively abundant.

Grass and grain pests. *White grubs* have been extremely numerous in portions of Albany, Columbia and Rensselaer counties, at least. They were so abundant in many places as practically to

kill the grass over areas half an acre or more in extent. The roots were almost entirely destroyed and in many fields much of the sod was, as a consequence, torn loose where a horse rake was used. The outbreak was taken advantage of by the Entomologist to study in representative spots, the work of the grubs, their habits and natural enemies, with special reference to methods of control. A detailed account of his investigations is given elsewhere.

The *Hessian fly* caused serious losses in the wheat-growing section of western New York, destroying entire fields and, in many cases, reducing the yield by 50 per cent. An investigation of the injury was made for the purpose of ascertaining any peculiarities in its inception and determining the probabilities of serious damage another year. A number of parasites were reared from infested wheat stems collected in representative areas. An extended discussion of this insect is given in the Entomologist's report.

The *fall army worm,* another grass and grain pest, was excessively abundant in the vicinity of New York City, seriously injuring lawns, destroying millet and corn and feeding upon a variety of grasses. This outbreak was also investigated and a detailed account of the insect has been prepared.

Shade tree pests. The widespread and severe injuries of earlier years by the *elm leaf beetle* in the Hudson valley in particular, amply justified extended observations the past season. It was found that the exceptional damage in 1911 resulted in a feeble growth and weakened trees the past season. The early portion of the spring was unusually cool and moist and largely, as a result of these conditions, it is believed that injury by this pest was not so severe as last year. There was a marked irregularity in the work of the beetle, some trees in a locality and in certain cases some localities being almost exempt from injury, while in others the damage was relatively severe. A portion of this may be explained, possibly by more thorough spraying. Experiments were conducted with sweetened and unmodified arsenate of lead for the purpose of ascertaining if any material advantage was to be gained by the addition of a cheap sugar or molasses. There was no marked difference between the two series of tests and the earlier work with poisons was confirmed in large measure.

The *false maple scale* continues abundant in the vicinity of New York City and was a subject of considerable correspondence during the summer. The *cottony maple scale* was also responsible for a number of complaints.

Forest pests. The *hickory bark beetle* has continued its destructive operations in the vicinity of New York City. The abundance of this pest and the hearty cooperation of Mr J. James de Vyver, of Mount Vernon, made possible a series of tests for the purpose of finding some method which could be relied upon to destroy the insect after the beetles had entered the trees. Studies in the field showed that in some localities many of the grubs died within a few weeks after hatching and before they were able to cause material injury. A detailed discussion of this work, together with the Entomologist's investigations upon the biology of the pest and its natural checks, is given in his annual report.

Many of the white pines in the vicinity of Albany have been killed in recent years by *bark borers*. The Entomologist's study of the conditions showed that in all probability this attack was the outcome of extreme droughts and very low winter temperatures. Parties suffering from the activities of these pests have been advised to cut and burn all infested trees prior to the opening of another season.

Hosts of *Ambrosia beetles* belonging to the genus Platypus attacked freshly sawn, sappy mahogany in the yard of a veneer cutting company near New York City and inflicted severe loss besides causing grave apprehensions. An investigation showed that the insects originated from a shipload of mahogany from Panama. Upon the advice of the Entomologist, the infested material was removed and the few insects remaining soon disappeared.

The destructive work of the *locust leaf miner,* noticed in the Entomologist's report, was studied the past season and additional information secured in relation to its habits and methods of control. The most severe injury, as in 1911, resulted from the feeding of the beetles.

The *woolly bark louse* of the white pines has been the occasion of several complaints during the past summer, and an investigation showed that in some instances at least, large trees were seriously weakened if not destroyed by this insect.

A previously unknown though sparse colony of the periodical *Cicada* was located at Geneseo as an outcome of the interest aroused by the appearance of the enormous brood last year.

Flies and mosquitos. There has been a general interest in controlling the house fly and preventing the superabundance of mosquitos. Both of these insects have been the subject of correspondence, and a number of bulletins giving directions for remedying undesirable conditions have been distributed.

An unusual departure was the working out of the life history of a common blowfly, Phormia regina Meign. and a flesh fly, Sarcophaga georgina Wied., under controlled conditions. These two insects, though exceedingly common, were comparatively unknown except in a very general way. The details of this investigation, undertaken for the purpose of solving a specific problem, are given in the Entomologist's report.

Gall midges. This large group of small flies has continued to receive attention from the Entomologist. He has succeeded in identifying the wheat midge of Fitch, which proved to be an undescribed species, discovered and described a second form recorded as living in heads of American wheat, and reared another. The last was identified through the cooperation of European entomologists as Thecodiplosis mosellana Gehin. In addition, a number of new gall midges have been reared from various food plants and described. The outbreak by the *Hessian fly,* noted above, and an abundance of the *pear midge* in the vicinity of Albany afforded opportunity for additional studies of two economic forms.

Lectures. The Entomologist, as in past years, has delivered a number of lectures upon insects, mostly economic forms, before various agricultural and horticultural gatherings. This work enables him to become personally acquainted with the problems of various localities and has been greatly facilitated by a chart showing the results secured in the codling moth experiments of recent years.

Publications. A number of brief, popular accounts of the more injurious species of the year were widely circulated through the agricultural and local press. The more extensive publications, aside from the report for last year, are: *The Elm Leaf Beetle and the White Marked Tussock Moth* (Museum Bulletin 156),

Control of Insect Pests in Institutions, The Identity of the Better Known Midge Galls, The Fundamentals of Spraying and several papers describing new species of gall midges. A list of the Entomologist's more important publications is given in his annual report.

Collections. There have been material additions to the collections through the efforts of the members of the office staff, and also by exchange and donation. Through the courtesy of Dr Otto Nüsslin of Karlsruhe, Germany, the Museum received an excellent series of European bark beetles. Mr Henry Bird, of Rye, generously donated an admirable lot of reared stem borers belonging to *Hydroecia* or closely allied genera, a number of these forms being almost unrepresented outside Mr Bird's exceptionally fine collection. The work of arranging and classifying the Museum collections has continued whenever opportunity offered. Considerable miscellaneous work has been done upon the beetles or Coleoptera, giving special attention to the flea beetles, Halticini of the Chrysomelidae and to the June beetles, Lachnosterna and its immediate allies of the Scarabaeidae. An excellent series of genitalic mounts was made in this latter group.

The value of the collections has been greatly increased by microscopic preparations. Specimens of the Scolytidae received from Doctor Nüsslin and noted above were put in balsam mounts. There were, in addition, two hundred such preparations of gall midges, mostly from reared material, and a number of scale insects, some previously unrepresented in the collections, which were similarly treated. The value of this material is much enhanced when placed in such preparations, since the latter are permanent in character and, in most of the species mounted, necessary for the identification of the insect.

The series of plant groups designed to serve as an embellishing and instructive feature of the enlarged exhibit now in preparation are practically completed. There has been special collecting for this exhibit.

The more ample facilities of the new quarters bring added responsibilities in the opportunity they offer of making the State collection of insects, both for exhibit and reference, thoroughly representative. The magnitude of such a task is appreciated by very few. The Entomologist recently assembled, with the cooperation of recognized authorities in various groups, the best obtainable

figures as to the number of American insects. The data are tabulated below:

Hymenoptera	10000	Orthoptera	950
Coleoptera	11255	Neuroptera and Pseudoneuroptera	2000
Diptera	9100	Thysanoptera	118
Siphonotera	115	Other small orders	500
Lepidoptera	6622		
Hemiptera	3328		43988

A recent catalog of the insects of New Jersey, a state with a considerably smaller area and lacking the climatic and other diversities of New York, lists over 10,000 species. It seems conservative to place the probable number of insect species existing in this State at twice that figure. A thoroughly representative collection of New York forms should therefore contain well toward 20,000 native species, and since each has at least four well-marked stages, some 80,000 different forms. Many species and a great number of the stages are unknown. There is ample work to occupy a well-equipped corps of entomologists in the State Museum for many years, not to mention the much additional labor involved in assembling and maintaining greatly enlarged entomological exhibits.

Nursery inspection. The nursery inspection work conducted by the State Department of Agriculture has resulted in the Entomologist being requested to make numerous identifications and also recommendations in regard to the policy which should be pursued by the State. Many of the specimens submitted for name were in poor condition, and as they may represent any stage in insect development and frequently originate in a foreign country, such determinations are laborious and time-consuming. The correct identification of such material is, however, very important, since the disposition of large shipments of nursery stock must depend, in considerable measure, upon our findings.

Miscellaneous. In cooperation with the Division of Visual Instruction, the Entomologist secured an excellent and somewhat extended series of photographs, mostly of injurious or common insects. This material was all taken in connection with other collecting, it only being necessary to pose the specimen for the photographer.

VII

REPORT OF THE ZOOLOGIST

The time of the Zoologist and Taxidermist has been occupied chiefly in cleaning, repairing and packing the zoological collections for removal, especially those that were on exhibition in Geological Hall. As it was desired to keep the Museum open to the public as long as practicable, but few of these exhibits had been disturbed during the previous fiscal year, although the duplicate and study collections, with the exception of many of the shells, had been mostly packed. The shell collection was the most difficult to handle on account of the great number of specimens both on exhibition and in storage. As most of the shells were in uncovered paper trays, with loose labels laid upon them, it was important to pack them so that all chance of confusion would be avoided. This work occupied much of the time of the Zoologist and Taxidermist during the entire winter and part of the spring.

The bird and animal groups could not be packed, and it was decided to leave them as they were and have them carefully transported without packing. The single mounted birds and animals were, when not of too great size, packed in boxes by securing the stands to the bottom or sides of the box. When it seemed necessary, the specimen was given additional support to prevent shaking. Those too large to be dealt with in this way were wrapped in several thicknesses of tissue paper which was carefully tied on. In many cases, the specimens were cleaned and repaired previous to packing, but this was not always possible, on account of the large amount of material to be handled. This work had been largely completed by the end of the fiscal year.

The services of Mr C. E. Mirguet, formerly of Ward's Natural Science Establishment, and now in the employ of the United States National Museum at Washington, were obtained for taking apart and cleaning the skeletons of mammals and other vertebrates. The smaller ones were prepared for transportation without entirely disarticulating them, the skull, or the skull and limbs, being removed and packed so as to diminish the danger of breakage. The skeleton of the finback whale, which was hung

by chains from the beams of the roof in the back wing of Geological Hall, was taken down, entirely taken apart and thoroughly cleaned by Mr Mirguet, and the skeletons of the other large mammals were similarly treated after disarticulating them as much as necessary.

Although the Museum has not been officially open to the public, people desiring to see the collections were not excluded from the exhibition rooms until the dismantling of the exhibits had progressed so far that too little remained to attract visitors, and the spaces in the exhibition rooms were required for the storage of the packed material.

MONOGRAPH OF THE NEW YORK MOLLUSCA

Dr H. A. Pilsbry's work upon the monograph of the New York Mollusca during the year has been directed chiefly to determining the generic characters of numerous forms hitherto inadequately known. To this end, considerable collecting has been done in the Hudson valley, Onondaga county and elsewhere to procure fresh, living material for description. Some forty-five figures of living mollusks have been drawn by the author, including, among others, representatives of the following genera:

Lyogyras	Planorbis	Zonitoides
Amnicola	Segmentina	Gastrodonta
Pomatiopsis	Physa	Helicodiscus
Valvata	Pupilla	Vallonia
Goniobasis	Bifidaria	Arion
Lioplax	Vitrea	etc., etc.
Lymnaea		

The external anatomy of part of these genera has hitherto been known in American works by figures of foreign species copied from European works, or by very crude figures and descriptions. The external soft parts of part of them have not before been figured or described. It is believed that the new facts brought out in the course of this work on American species are ample compensation for the time and labor spent thereon. Further work has been done on the descriptive part, and a large number of illustrations made, figuring all of the species which have been worked up. The completion of the monograph is expected next year (1913).

VIII

REPORT OF THE ARCHEOLOGIST

The work of the archeology section, as of all other sections of the Museum, has this year been modified to a considerable extent by the necessity of preparing to move its collections and office quarters into the Education Building.

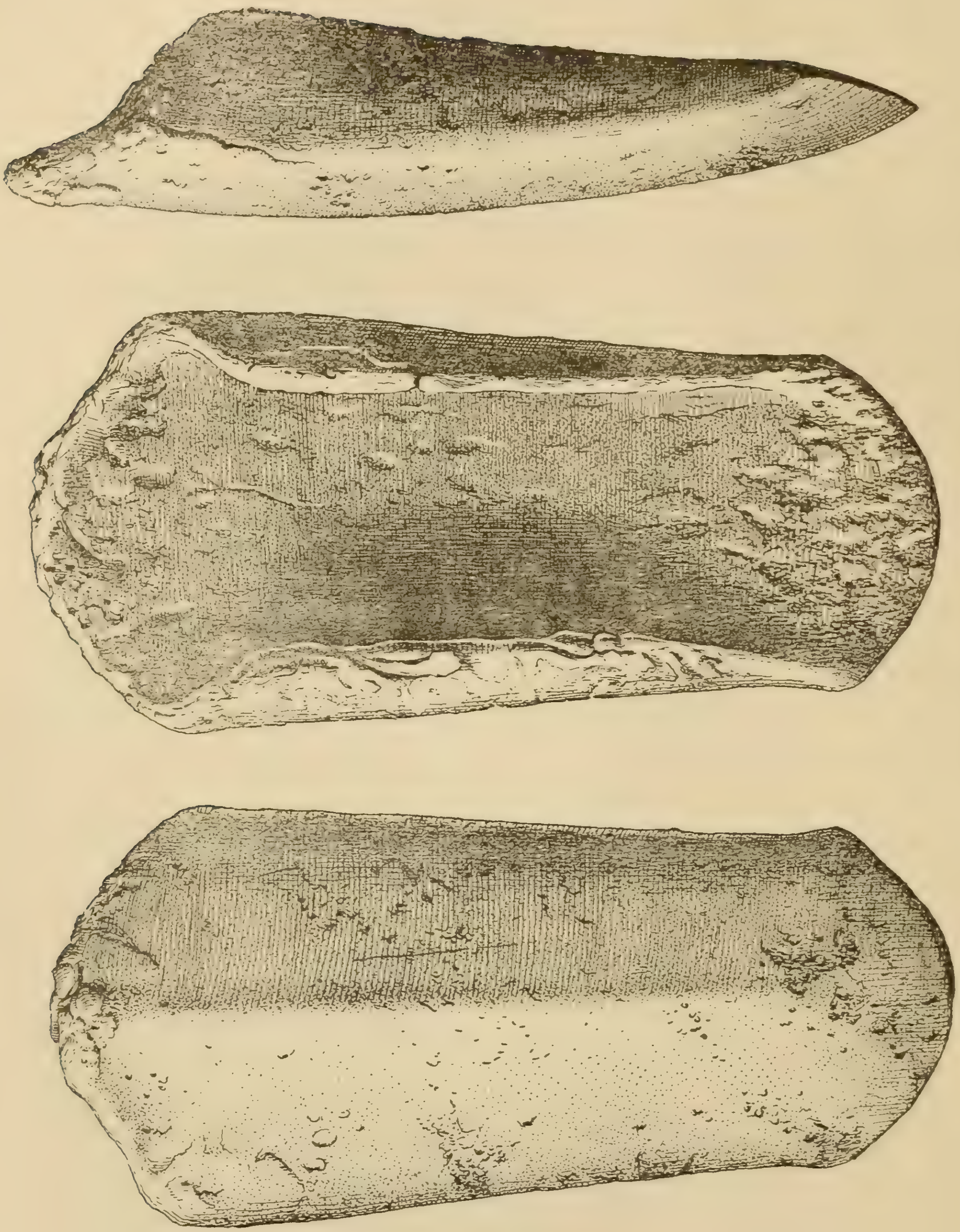
With the close of the fiscal year 1911 the Archeologist had about completed the preliminary work necessary for the exhibition of the Seneca Hunter group, in the ethnological series. A photograph of this group was reproduced in this report last year. With the assured success of the plan for this series of groups depicting Iroquois culture, steps were taken to complete all the preliminary work necessary for the plan.

The field painting of the Nichol's pond site was enlarged by Mr D. C. Lithgow, whose artistic ability and skill have been useful. This painting now complete is nearly fifty feet long and eighteen feet high and, like all others, is designed as a background for one of the groups. Further mention of this work will be made in the succeeding pages.

All the collections in the Archeologist's quarters in the Universalist Church building were packed and prepared for moving. It has therefore been impossible to make any further study of this material.

ARCHEOLOGICAL SURVEY

In cooperation with the United States Bureau of Ethnology, this section of the State Museum during the year has sent out several thousand requests for information concerning the sites and remains of former aboriginal occupancy. Reply envelops and blank forms for filling out were sent and about 75 per cent were returned with data filled in. In the majority of cases, these request forms had been sent to the presidents of local boards of education, to library presidents, to county clerks and to collectors, and thus to citizens who were familiar with the localities in which they lived. Several hundred new sites were added to the long list already in the possession of the Museum and will be properly tabulated. This information will not only be of the highest importance to the State Museum, but will form the body of the material used by the Bureau of Ethnology in its "Handbook of Aboriginal Sites and Remains."



Three views of a copper gouge from Canton, St Lawrence county

An attempt was also made to make a "census" of all the collections of aboriginal artifacts in the State and a new index has resulted, giving the lists of several hundred collections. In this manner, more than any other, an idea can be obtained of the localities most thickly populated in aboriginal times, but there is seemingly no correspondence between the abundance of earth works and the abundance of specimens. Large numbers of objects from all the various types and successions of occupancy are in the possession of individual collectors. The correspondence and indexing necessary to collect and file these statistics consumed a greater portion of the time up to May, but the knowledge gained is of practical as well as of high scientific importance.

In passing, it should be mentioned that many collections held by private individuals are neither numbered nor adequately cataloged. The collectors almost without exception remember where their objects were found, but without a permanent record the collection is robbed of its highest usefulness, and with the death of the owner, the otherwise valuable and instructive series becomes a mere aggregation of curiosities known as "Indian relics." In these days when the collection of such artifacts has a scientific object, every care should be taken to give each its precise locality. Topographical maps are of much use in this connection.

THE O. W. AURINGER COLLECTION

Supplementing in an important way the Dr A. W. Holden collection, donated last year by State Historian James A. Holden, is the Rev. O. W. Auringer collection, generously donated to the Museum by Dr Albert Vander Veer, of the Board of Regents. This collection is from about the same district as the Holden collection, that is Queensbury township and the region about Troy, north to Lake George.

An examination of the collection donated by Doctor Vander Veer reveals some important archeological facts which, supplemented by Mr Auringer's notes, give the collection a valuable place in our archives. The region from which the collection comes is characterized by several different occupations.

There have been unearthed on several Queensbury sites, flint knives and lance heads so old that the original flint — itself about the hardest of stones — had so far changed in substance as to

have become chalky white in color, and in some cases so soft as to permit whittling with a sharp knife. Other objects have suffered surface changes from the original dull black of the stone to a lustrous yellow, or buff, or mottled color, according to the difference in soils in which they were imbedded. Such changes in the appearance and structure of flint can come only through exceedingly long and slow processes, and are occasioned by the percolation through soil of water charged with certain chemical elements, the effect upon the stone being the disintegration or final breaking down of one of the two kinds of silica of which it is composed.

The older artifacts occur mainly on a few extensive sites about the southern end of Lake George; at East Lake George; at Glen lake, and on a large site on the eastern town line about half way between Dunham's bay and the Hudson river at Sandy Hill. These sites, which Doctor Beauchamp calls "Early sites," are easily recognized by the initiated, on account of the remains they yield. Massive spear or lance heads, thick and heavy, yet in many cases almost as symmetrical and orderly in construction as if they had been wrought by machinery instead of by hand and eye; knives of flint and fine sandstone, thin and carefully wrought, leaf-shaped in form and edged all around, flaked by unground axes of sandstone and quartzite; acutely edged, finely shaped adzes and gouges of fine sandstone, of hollow and round-backed types; on the waterside sites large flaked disks of coarse sandstone, worked to an edge all around.

Following these traces of earlier men in Warren county, are the rather more broadly-sown of the two succeeding populations of different habits and instincts from their predecessors, and in these same respects also differing quite as much from each other. Our present knowledge in the matter does not definitely justify us in saying which was the earlier of the two, but their large and often curiously decorated pestles and mortars of stone show that they had a knowledge of agriculture. The Eskimo relics discovered point this people as once inhabiting our lands. For the sake of convenience only, we will turn our attention first to the traces of the first-mentioned people, in an endeavor to outline their habitat and realize something of their character and employments. They were agriculturists, huntsmen and fishermen, drawing from soil and forest and lake and river, their means of living. This signifies that they were a people of

active energy; ambitious, resourceful, with an eye to the main chance — in short, in industrial affairs what the Mohawk was in war. They were inventive, with a decided instinct for art, shown in the decorative effects produced in the manufacture of their weapons and utensils. In their manipulation of stone, they were not satisfied with mere utility. They made an arrow or spear head an object of beauty to the eye, and manifested an accurate taste in the smoothness and symmetry of their pestles when any roughly-dressed stone would have served as well in a practical way. They were makers of pottery, small and large vessels of mingled clay and finely pounded stone, fire-baked and elaborately decorated, though in common with those preceding and following them, they were wholly ignorant of metallurgy.

Beginning at the oft-occupied settlement on the north bank of the Hudson river at the Big bend, we will endeavor to trace the lines of their residence to the northward to Glen lake, thence eastward into Washington county. Here at the rifts of the Hudson are found in the lower layers of soil, quantities of their pottery, celts, knives etc., while all to the north and northwest along Clendon brook and Meadow run, are yearly ploughed up their cylindrical pestles with an occasional mortar. Axes, knives, arrowheads and pottery are found in remarkable quantities. At the southern end of Glen lake, on the plateau where the Glen Lake hotel now stands, was a considerable village stretching thence to the elevated lands on the opposite bank of Meadow run, where that stream enters the lake. Following the western shore of the lake in our survey, we find few traces till we reach the outlet at Butternut flats. Here, on both banks of the creek, which at this point are much elevated, seems to have been an established town, with offshoots in various directions, first to the westward on the small brook near the Halfway house on the highway to Lake George. Then another northwestward, tucked for comfort up under the protection of French mountain, where a cold stream comes down from between the two spurs. Here the writer picked up, among various other objects, an arrowhead of pure transparent quartz crystal. These sites are identified by the fragments of early pottery which they yield. From Glen lake eastward the line of these old habitations follows the stream at intervals through to the Washington county line. Tradition refers to a stone-fortified village at Sanford's bridge, near Halfway brook, which, if tradition is correct, was evidently

occupied by this people, since the frequent remains found in this neighborhood bear the stamp of their workmanship. A half mile to the eastward of this point, and under the high banks to the right of the Kingsbury road to Sanford's bridge, is a small site yielding large quantities of unworked flints. It would appear that these agriculturists worked the sand plains about the falls of the Hudson, as these two points are within the limits of the city of Glens Falls, which was inhabited; one on the site of the present French Catholic church, which has yielded large pestles, and another back of the city cemetery, and between it and Upper Glen street, producing various flints. That these early inhabitants were frequent visitors at Lake George in quest of game, is evidenced by the location of several of their camps, notably one at the head of the lake and another at Dunham's bay. We could not rationally expect to find here samples of their farming activities, from the nature of the soil, nor do we. But the pottery is in evidence here, showing that, like their white successors, they appreciated the advantages of life and health, which lie in frequent more or less protracted fishing and hunting trips. These small sites — there must be many more of them along the shores and among the islands — were their camps.

Returning to our base as Glen lake, we find traces along the eastern shore; and branching near the head of the lake a line of population followed very nearly by the present line as far south as the neighborhood of De Long's brickyard. Spreading to the east and west, this takes in the famous Blind rock and Hunter's brook tracts with the immediately adjoining territory.

One of the very interesting local problems is the relation of the Eskimos to the region east of Canada and to the former inhabitants of the upper half of New York State — about the Great Lakes, the St Lawrence river and the adjacent smaller streams and lakes. The Eskimos of Point Barrow retain in present use a certain kind of blade or knife of slate, ground and finely polished, in length of three to eight inches, stemmed and usually barbed, sometimes thin and flat, with a narrow bevel to form the cutting edges, often more thick, beveled off from a central longitudinal ridge running the length of the blade. These tools are singular in that no other existing peoples use them, nor from what follows does it seem that any other people ever did use them. In the portion of Canada bordering the Great Lakes, and about the streams and lakes in the

upper half of the Empire State, many tools of identical character are found in the soil, associated with other objects such as flint arrow points, chipped quartzite blades, and the peculiar form of chipped flint scraper in archeology known as the Eskimo scraper, from its identity with like tools in use by the Eskimo of the north at the present time. Dr William M. Beauchamp, whom we esteem the best authority in archeological matters relating to our State, has furnished an excellent study of these remains; and he seems unhesitating in his belief that at some period quite remote, the regions about and to the northward of us were the established homes of the tribes now inhabiting the far north, known as the Eskimos. The truth would appear to be, that this was their home at a remote period, when the climate retained considerably more of arctic severity than is known at present; and that, following the receding cold upon the gradual encroachment of warmer conditions, and the migration of the cold-loving animals upon which they subsisted, they tended gradually northward till they at length found in the utmost north the favorite conditions of their well-being. Their chief habitat in the town of Queensbury was about Glen lake. There, at the northern end, or outlet, was a large, permanently established town covering many acres, from which ran lines of habitation in various directions: first northward under the base of French mountain for a distance, then striking off to East Lake George, where, as we might expect, there was a large village; second, a shorter line, comprising three small sites, with its terminus at Lake Sunnyside. Here, on the abrupt hill on the west shore of the lake was one of their lake dwellings. In the collection from Queensbury just donated by Dr Albert Vander Veer, is a card of several specimens of the "polished slate knife," among which is one obtained from the Washburn farm at French mountain, about a mile from Glen lake. It is made from Kingsbury banded red and gray slate, the red predominating, is of lance-head form, seven inches in length, by about one inch in mean breadth, has a central longitudinal ridge on each surface, is acutely pointed, with sharp edges. The stem is notched and there are well-defined barbs. With one exception this is the finest object of its kind among the one hundred and odd specimens so far reported. Saratoga lake has furnished a few of these knives, and two specimens have been discovered at Marcy, in Oneida county. They are

rather more common about Lake Ontario and the neighborhood of Oneida lake than on the two sites just named. Prof. D. F. Thompson of Troy obtained one from the Bolton shore of Lake George; and from Lake Champlain, as we might expect, come a few others. A single specimen, the largest, but also the rudest in point of finish yet reported, comes from the Maine lakes.

Exactly what took place here at the close of the period we have been considering we do not know. But, by means of the alphabet of relics, supplied by the superficial soil, we are able to spell out a period of great confusion. The country here seems to have been overrun from about every quarter, judging from the pattern and material, foreign to the locality, of relics scattered so profusely about our fields. Flint from Ohio and farther west; copper from Michigan; grooved axes and soapstone pottery from the Atlantic tract; opaque quartz, and even obsidian, from the south — all these meet and dispute for the notice of the archeologist on Queensbury ground. At Assembly point, on Lake George, is a site yielding beaten copper spear and arrowheads. In Mr Auringer's explorations, he found a large grooved and polished limestone axe from the often-occupied site in Harrisena; and in line of association, fragments of large steatite, or soapstone pottery, have been taken from a site southwest of Glens Falls by a local collector. This signifies the presence in the intermediate period of the New England Algonquins. On Harrisena site again are found broad, thin and symmetrical polished limestone celts of quite other origin than the axes. How long the season of confusion lasted, it is impossible to know.

The territory including Queensbury was in the Algonquins' hands when the Europeans appeared on the scene. Having driven out the Iroquois, they ruled once more undisturbed in their ancient habitat. The Iroquois had gone down by two principal routes to the Mohawk valley, where they had already, prior to the advent of the whites, formed their powerful Confederacy. One of these routes was by the St Lawrence and Lake Ontario. The other was by the Champlain and Lake George trail to the Hudson river, and thence to the mouths of the Mohawk. It is possible to trace their line of migration from Dunham's bay southeastward to the county line and on to the Hudson at Hudson Falls. The first stage of this overland exodus is well marked by the remains of a considerable town situated on the flats bordering the inlet at Dunham's bay. From this point

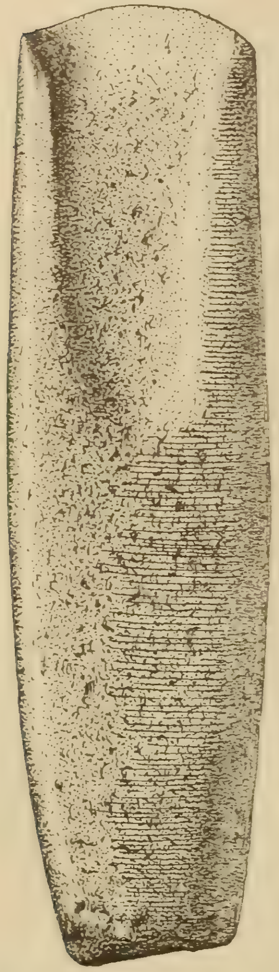
Slate knives, probably of Eskimo origin from Glen lake, Saratoga county. Auringer-Vander Veer collection.

the trail ran southeasterly for some miles (a day's journey for an Indian) to a station on the county line road lying about the sources of Cold brook. Here the remains of occupancy are spread over many acres, and encroach upon and partly cover a permanent village site of the earliest inhabitants, whose remains have already been described. The relics of these two sites are exactly of the same character as those from Iroquoian stopping places on their westernmost route by way of the St Lawrence. They consist of fragments of the well-known clay pottery of the Mohawk tribes; pipes of red pottery; small triangular flint arrowheads; acutely edged celts and a few small flint knives.

A few years ago there was found on the site of the big bend a fine specimen of the steel "trade axe" with which the traders first armed their red neighbors. This is included in this collection and is in a fine state of preservation. There is also a fine and keen steel arrow and shaft, obtained from a site at the western base of Sugar Loaf mountain. Objects of copper have been found at the same place. A broken stone pipe drilled with steel tools of the white man comes from Glen lake. On the Bay road, on the farm owned by Elber Titus, was a Mohawk camp of late date. In addition to the small flint implements supplied by such stations, this field yielded one of the choicest objects of Mohawk manufacture which it has been my good fortune to record. It is a flat limestone pebble three inches in mean diameter, carved into the form of a young buck's antlers, and perforated at one side near the base for the purpose of suspension. Both surfaces are delicately carved into ridges, giving a corrugated appearance. It belongs to a class of objects termed personal ornaments. About Lake George and on many of its islands are frequent finds of Mohawk relics made. But the Mohawk never returned to occupy the country as a permanent residence. What we find of him here are but the remains of these temporary hunting or war camps, for he was often attracted this way from his home on the "Beautiful river," by the scent of game or scalps; but it was only as an intruder that he came.

In their manufacture of stone implements, the aborigines used such material as was found in their neighborhood. Where supplies of flint were lacking, they made use of native quartzite and even sandstone for their smaller weapons, as arrowheads, knives, and spear points, as well as for heavier tools. These native supplies

they supplemented with flint in the block obtained by way of trade with neighbors occupying a flint-producing region. In Queensbury, we find the occupants of all periods using the local quartzite pebbles freely for long axes, celts, or hand axes, the larger class of spears and knives, and scrapers; while the local sandstones supplied the place of harder material for certain gouges and adzes. Laminae of fine sandstone served for the manufacture of finely wrought knives and lanceheads. The Eskimo worked the silex, or white flint deposit, on French mountain for material in the manufacture of large knives and spears, and even small arrowheads, while the neighboring slate quarries of Washington county served him in the matter of material for slate knives, ground and unground. And certain ceremonial stones, as the perforated gorget, bird and bar amulet, and often a banner stone, used by his predecessors, were of the same material. Many chisels and axes were made of the black limestone of the region, which was a favorite on account of the high polish it takes. Greenstone and conglomerate pebbles were utilized for celts and banner stones. At the foot of Glen lake was found a thick celt, or hand axe, of brown hematite, or ironstone. Hornstone and various flints often occur in limestone deposits; and doubtless the native miner understood the location of material of such value to him, in these eastern tracts. Nevertheless much flint in the rough must have been brought in from the western sources.[1]

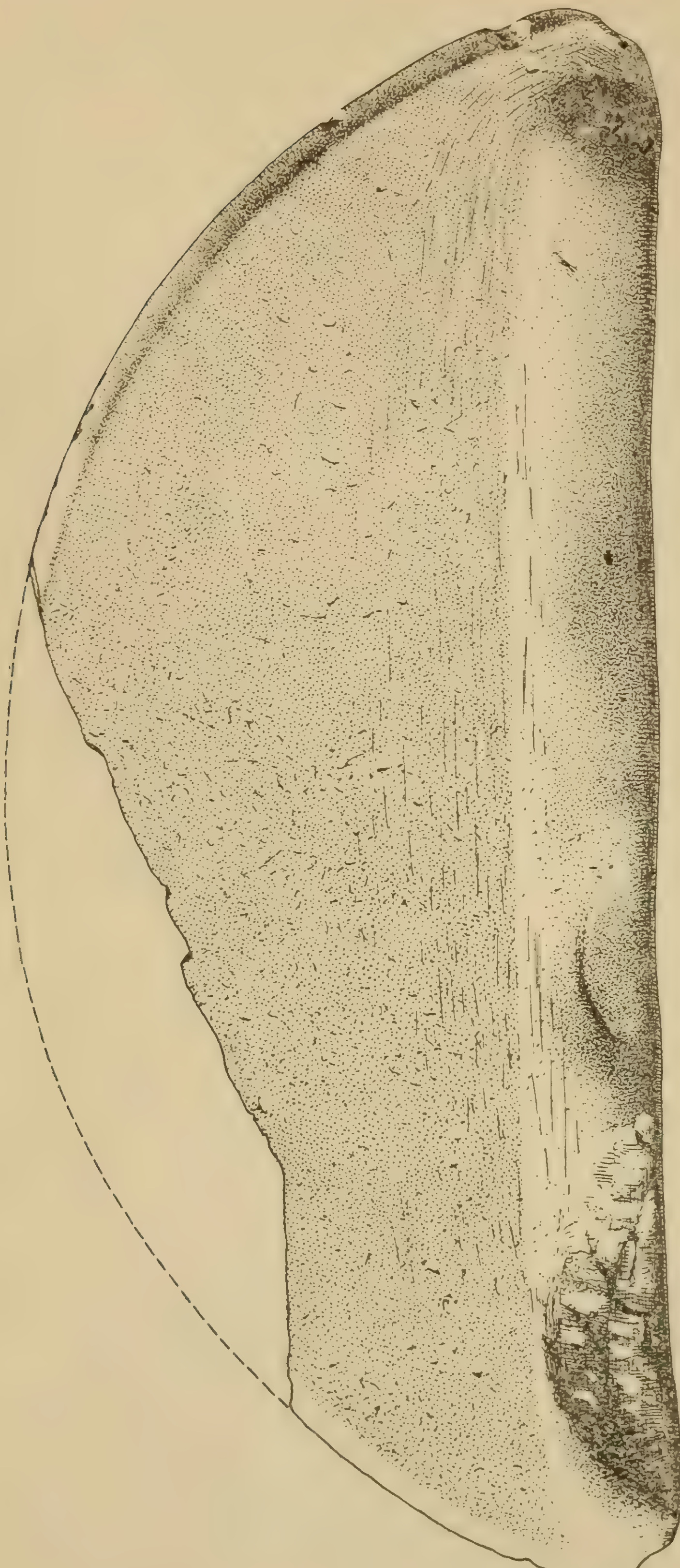


Typical gouge from Warren county

ARCHEOLOGICAL COLLECTIONS

Among other interesting objects are a series of flints from Green Island and a semilunar or woman's knife from the mouth of the Hoosic river. This latter object was donated to the Museum by Mr Albert Hurd, of Troy, and represents one of the largest semilunars found in this region. It is a rare and valuable specimen and its donor is entitled to special thanks. A representation of this knife is shown in the accompanying figure.

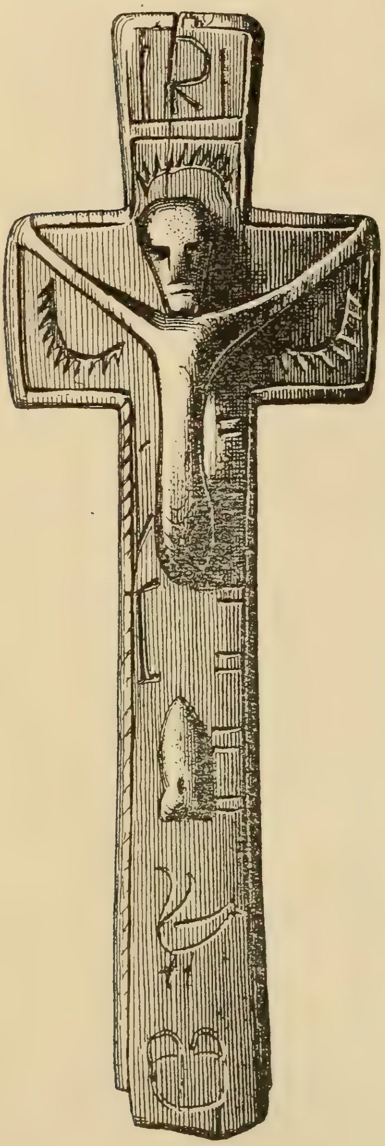
[1] See N. Y. State Hist. Rept. by Auringer, 8: 102–12.



Semilunar knife from mouth of Hoosic river. Donated by Albert S. Hurd

An important mound was excavated during the year by Mr E. R. Burmaster, and a fine type of a mound skull obtained. This mound is in Chautauqua county and is one of the largest of its kind in the State.

A unique acquisition and addition to our collection of early religious objects is a crucifix obtained by Miss Pearl Hoppel in an old farmhouse at Fallsburg. It was evidently made by some Delaware or Minsi Indian in the early days and indeed has two totem animals of the Minsi carved upon it. The accompanying figure shows a representation of this object.



Crucifix probably carved by Minsi Indians. From Fallsburg, N. Y.

FOLKLORE

The study of the Iroquois rites and folklore was continued with much success. Valuable additions were made to the notes on the wampum codes and condolence ceremony. Mr Albert Cusick, long the helper of and coworker with Dr William M. Beauchamp, and previously the interpreter for Horatio Hall, was of much assistance in this connection. Mr Cusick is an Onondaga by birth and has long been regarded by the Onondagas, and indeed by all the Six Nations in New York, as their greatest authority on the council rites of the League of the Iroquois. In October, a few weeks after the Archeologist had completed his notes on tree symbols and myths, Mr Cusick died. This serves as a reminder of the fact that speedy work must be done if any amount of information is to be recorded. With the death of Chief John Gibson, of the Six Nations of Ontario, in October, another native annalist passed beyond reach. Mr Gibson had also been of considerable assistance to this section of the Museum.

With the corrections made by Chief Edward Cornplanter on the Code of Handsome Lake, the Seneca prophet, a manuscript

version of the teachings of the celebrated Seneca chief, the manuscript was revised and with explanatory notes and appendixes, was submitted as a bulletin in the Museum archeological series. This work, now in press, will be a free translation of the religious belief of the modern nonchristian Iroquois of New York and Ontario, and should prove a work of some psychological as well as sociological and ethnological interest. It was Handsome Lake who revolutionized in sixteen years the disintegrating Seneca and Onondaga tribes and recrystalized their native beliefs. This was accomplished at a critical moment in the history of the Iroquois — immediately after the Revolutionary War, when the Iroquois League was broken and disheartened. Handsome Lake's teachings gave a new life and a new hope. The bulletin will be no. 16 in the archeological series.

PUBLIC INTEREST

Public interest in the work of the archeological section is attested by the large number of letters of inquiry which have come to this office and the many requests for information.

To museum authorities, especially, the plan for the ethnological groups has made an appeal, and a considerable number have visited the workshops for information as to methods.

IX

PUBLICATIONS

A list of the scientific publications issued during the year 1911–12, with those now in press and treatises ready for printing, is attached hereto. The publications issued cover the whole range of our scientific activities. They embrace 926 pages of text, 122 plates and 19 maps.

The labor of preparing this matter, verifying, editing and correcting is onerous and exacting. Taken altogether, it excellently indicates the activity and diligence of the staff of this division.

ANNUAL REPORT

1 Eighth Report of the Director, State Geologist and Paleontologist for the fiscal year ending September 30, 1911. 218p. 42 pl.

Contents:

Introduction
I Condition of the scientific collections
II Report on the geological survey
Some practical features of New York geology
Areal geology
Surficial geology
Industrial geology
Seismologic station
Mineralogy
Paleontology
III Report of the State Botanist
IV Report of the State Entomologist
V Report of the Zoologist
VI Report on the archeology section
List of archeological specimens destroyed in the Capitol fire, March 29, 1911
VII Publications
VIII Staff
IX Accessions
Notes on the Geology of the Gulf of St Lawrence. J. M. Clarke
Notes on Devonic Fishes from Scaumenac. L. Hussakof
Notes on a Specimen of Plectoceras jason (Billings). Rudolf Ruedemann
On the Genesis of the Pyrite Deposits of St Lawrence County. C. H. Smyth, jr
Recent Mineral Occurrences in New York City and Vicinity. H. P. Whitlock
The Micmac Tercentenary. John M. Clarke
The Manhattan Indians. Alanson Skinner
Index

BULLETINS

Geology

2 No. 153 Geology of the Broadalbin Quadrangle. By W. J. Miller. 1911. 66p. 8pl. 1 map.

Contents:

Introduction
General geography and geology
Precambric rocks
Paleozoic rocks
Faults
Physiography
Summary of geologic history
Economic products
Index

3 No. 154 Glacial Geology of the Schenectady Quadrangle. By James H. Stoller. 1911. 44p. 9pl. 1 map.

Contents:

Introduction
Topography due to rock surfaces
Modifications of rock topography during Pleistocene period
Surface deposits
Economic values of the Lake Albany deposits
Modified till
Recent deposits
Review and summary
Index

4 No. 159 The Mineral Springs of Saratoga. By James F. Kemp. 80p. 3pl. 1912.

Contents:

Introduction
Historical sketch
Brief statement of the local geology
The fault at Saratoga Springs
Generalities regarding the normal ground waters
Composition and character of the Saratoga waters
Carbon dioxid
Water seal
Temperature of the waters
Specific gravity of the waters
Classification
Variations in the waters
Origin of the mineral waters
Tables of analyses
Index

5 No. 160 Glacial Waters in the Black and Mohawk Valleys. By H. L. Fairchild. 48p. 8pl. 17 maps.

Contents:

Introduction: outline of glacial history
Black valley glacial waters
Physiography
Outline of lake history
First stage: Mohawk waters; Herkimer lake
Second stage: Forestport lake; Remsen outlet
Third stage: Port Leyden lake; Boonville outlet
Fourth stage: Glenfield lake; Copenhagen-Champion outlet
Fifth stage: Lake Iroquois
Pre-Wisconsin topography
Mohawk valley glacial waters
First stage: early Adirondack drainage
Second stage; Herkimer lake
Third stage: Schoharie lake
Fourth stage: Amsterdam lake
Fifth stage: Lake Albany
Tributary lakes
Rock barrier at Little Falls
Divide at Rome
Summary of Mohawk drainage history
Correlation of Ontarian and Hudsonian Ice Lobes
Bibliography
Index

6 No. 161 Mining and Quarry Industry of New York. By D. H. Newland. 114p.

Contents:

Introduction
Mineral production of New York
Cement
Clay
Production of clay materials
Manufacture of building brick
Other clay materials
Pottery
Crude clay
Emery
Feldspar
Notes on the occurrence of feldspar in New York
Garnet
Graphite
Gypsum
Iron ore
Mineral paint
Mineral waters
Natural gas

Contents — (Continued) :

Petroleum
Pyrite
Salt
Sand and gravel
Sand-lime brick
Stone
  Production of stone
  Granite
  Limestone
  Marble
  Sandstone
  Trap
Talc
  The Gouverneur talc district
Zinc
Index

Entomology

7 No. 155 Report of the State Entomologist for the fiscal year ending September 30, 1911. 182p. 35pl.

Contents:

Introduction
  Injurious insects
    Codling moth
    Gipsy moth
    Green maple worm
    Iris borer
    Notch wing
    Maple leaf cutter
    Locust leaf miner
    Rosy Hispa
    Rose leaf hopper
    Periodical Cicada
A report upon the condition of the shade trees of the city of Mount Vernon, N. Y.
Experiments with heat as an insecticide
Notes for the year
  Fruit tree insects
  Small fruit insects
  Shade tree pests
  Forest pests
  Miscellaneous
Publications of the Entomologist
Additions to collections
Explanation of plates
Index

8 No. 156 Elm Leaf Beetle and White-Marked Tussock Moth. By E. P. Felt. 35p. 8pl.

Contents:

Introduction
Elm leaf beetle
  Results of attack
  Food plants
  Distribution
  Description
  Life history
  Natural enemies
  Preventive measures
  Remedial measures
White-marked tussock moth
  Description
  Life history and habits
  Food plants
  Natural enemies
  Remedies
Explanation of plates
Index

Botany

9 No. 157 Report of the State Botanist for the fiscal year ending September 30, 1911. 139p. 9pl.

Contents:

Introduction
Plants added to the herbarium
Contributors and their contributions
Species not before reported
Remarks and observations
New species and varieties of extralimital fungi
Edible fungi
New York species of Clitocybe
New York species of Laccaria
New York species of Psilocybe
Latin descriptions of new species and varieties
Explanation of plates
Index

GEOLOGIC MAPS

10 Broadalbin quadrangle
11 Schenectady quadrangle

In press

MEMOIRS

12 Birds of New York, volume 2
13 Eurypterida of New York

BULLETINS

Geology

14 The Geological History of New York State

Paleontology

15 The Lower Siluric Shales of the Mohawk Valley

Entomology

16 Report of the State Entomologist for the fiscal year ending September 30, 1912

Botany

17 Report of the State Botanist for the fiscal year ending September 30, 1912

Archeology

18 The Code of Handsome Lake, the Seneca Prophet

X

STAFF OF THE SCIENCE DIVISION AND STATE MUSEUM

The members of the staff, permanent and temporary, of this division as at present constituted are:

ADMINISTRATION

John M. Clarke, Director
Jacob Van Deloo, Director's clerk
Paul E. Reynolds, Stenographer

GEOLOGY AND PALEONTOLOGY

John M. Clarke, State Geologist and Paleontologist
David H. Newland, Assistant State Geologist
Rudolf Ruedemann, Assistant State Paleontologist
C. A. Hartnagel, Assistant in geology
Robert W. Jones, Assistant in economic geology
D. Dana Luther, Field geologist
Herbert P. Whitlock, Mineralogist
George S. Barkentin, Draftsman
H. C. Wardell, Preparator
Michael Sammon, Stenographer
Charles P. Heidenrich, Machinist
Joseph Bylancik, Page

Temporary experts

Areal geology

Prof. H. P. Cushing, Adelbert College
Prof. J. F. Kemp, Columbia University
Dr C. P. Berkey, Columbia University
G. H. Hudson, Plattsburg State Normal College
Prof. W. J. Miller, Hamilton College
Dr W. O. Crosby, Massachusetts Institute of Technology
Dr H. B. Kümmel, Trenton, N. J.

Geographic geology

Prof. Herman L. Fairchild, Rochester University

Paleontology

Edwin Kirk, Washington, D. C.

BOTANY

Charles H. Peck, State Botanist
Stewart H. Burnham, Assistant

ENTOMOLOGY

Ephraim P. Felt, State Entomologist
D. B. Young, Assistant State Entomologist
Fanny T. Hartman, Assistant
Anna M. Tolhurst, Stenographer
J. Shafer Bartlett, Clerk

ZOOLOGY

Willard G. Van Name, Zoologist
Arthur Paladin, Taxidermist

Temporary experts

Prof. E. Howard Eaton, Canandaigua
Dr H. A. Pilsbry, Philadelphia

ARCHEOLOGY

Arthur C. Parker, Archeologist

Temporary assistant

Howard A. Lansing, Albany

XI

ACCESSIONS

ECONOMIC AND GENERAL GEOLOGY

Collection

Newland, D. H. Albany

Building stones, rough and polished samples	25
Zinc and pyrite ores, St Lawrence county	20
Diabase dikes cutting granite, Dannemora, N. Y.	3

Donation

Uniform Fibrous Talc Co. Talcville

Exhibit of crude and ground talc	10

PALEONTOLOGY

Donation

Eastman, Dr Charles R. Washington, D. C.
Plaster restorations of Bunodes, Pterichthys and Cladoselache 3

Landreth, William B. Deputy State Engineer, Albany
Mammoth tooth found while excavating for lock 26, on the barge canal, near Clyde, N. Y. 1

Van Horne, C. F. Glen
Concretions from Schoharie creek, at Glen (Montgomery co.) containing Utica slate fossils 32

Exchange

Mathes, K. B. Batavia
Devonic fossils from various localities in Genesee county . . 125

Purchase

Plourde, Anthony. Migouasha West, P. Q.
Devonic fishes from Migouasha, P. Q. 120

Collection

Hartnagel, C. A.
Siluric fossils from Black Cape, P. Q. 1200

Ruedemann, R.
Fossils from Schuylerville sheet, Aries lake, Hyde Park, Schodack Landing 125

ENTOMOLOGY

Donation

Hymenoptera

Lewis, G. C. Lockport. Thalessa atrata Fabr., black long sting, adult, June 17

Dummett, Arthur. Mount Vernon. Apanteles congregatus Say, cocoons and adults, July 29

DeLong, E. W. Crown Point. Same as preceding, on Ampelophaga myron Cram., August 7

Mc Atee, W. L. Pickens, Miss. Cynips strobilana O. S., lobed oak gall, October 12. Also Neuroterus umbilicatus Bass., oak button gall on Quercus michauxii, October 12

Laney, C. C. Rochester. Andricus seminator Harr., wool sower, gall on white oak, June 21

Sherman, Miss Ruth H. Glens Falls. Same as preceding, June 24

Taylor, R. M. Ann Arbor, Mich. Neuroterus saltatorius Hy. Edw., galls on white oak, July 24

Blunt, Miss E. S. New Russia. Cimbex americana Leach, elm sawfly, larva on elm, September 20

Woodward, A. G. Through State Conservation Commission. Tremex columba Linn., pigeon tremex, adult, September 11

Brooks, E. C. Athens. Caliroa cerasi Linn., pear slug, larvae on pear, August 12

Robson, A. N. Lake George. Kaliofenusa ulmi Sund., elm leaf miner, larva on elm, June 13

Rutledge, Neil. Greenwich. Same as preceding, June 15

Devereaux, W. L. Syracuse. Same as preceding, June 19

Ward, J. G. Cambridge. Same as preceding, larvae and work on elm, June 24

Vail, Harry. New Mulford. Trichiocampus viminalis Fall., larvae, August 29

Coleoptera

Matheson, W. J. Huntington. Eccoptogaster quadrispinosa Say, hickory bark beetle, work on hickory, February 9

Merkel, H. W. New York City. Same as preceding, larvae and work, March 12 and June 17

Anderson, E. H. Scarsdale. Same as preceding, work, June 22

de Vyver, J. J. Mount Vernon. Same as preceding, adults and work, July 1

Dwyer, F. P. Yonkers. Same as preceding, work, July 30

Chapman, J. W. Dorchester, Boston, Mass. Eccoptogaster multistriata Marsh, imported elm bark borer, adults and larvae, October 5

Vitale, Ferruccio. New York City. Pissodes strobi Peck, white pine weevil, work on pine, July 11

Cunningham, Thomas. Vancouver, B. C. Thricolepis simulator Horn, gray, bark-eating weevil, adult on apple, May 2

Herrick, C. J. Elsmere. Pomphopoea sayi Lec., Say's blister beetle, adults on wild cherry, May 31

Hawley, G. H. Castleton. Coptocycla ? clavata Fabr., larva on morning glory, July 9

Gardner, M. H. Brewster. Galerucella luteola Müll., elm leaf beetle, adults, April 18

Crittenden, Mrs W. H. Cornwall. Same as preceding, May 10

Young, J. T. Watervliet. Same as preceding, eggs on elm, June 14

Gaskell, A. Ellenville. Same as preceding, adults, larvae and pupae on elm, July 11

Tate, L. A. Gloversville. Same as preceding, larvae and work on elm, July 16

Cook, W. M. Oyster Bay. Same as preceding, work on elm, August 5

Cunningham, Thomas. Vancouver, B. C. Glyptoscelis alternata Cr., leaf beetle, adult on apple, May 2

Rooney, J. O. Scarsdale. Elaphidion villosum Fabr., oak and maple pruner, larva and work on oak, July 24

Chatham Courier. Chatham. Monohammus confusor Kirby, sawyer, adult, July 10

Wend, Mrs George. Albany. Same as preceding, adult on pine, July 17

Bender, Matthew, jr. Niverville. Lachnosterna, June beetle, larva in grass sod, August 11

Woodward, W. M. North Chatham. Same as preceding, August 11

Moore, R. M. Rochester. Psephenus lecontei Lec., larva, September 25

Van Name, W. G. Albany. Dermestes vulpinus Fabr., leather beetle, all stages, March 26

Bernstein, Charles. Rome. Megilla maculata DeG., spotted lady-beetle, adults, December 13

Diptera

McAtee, W. L. Marksville, La. Thecodiplosis ananassi Riley, galls on Cypress, September 12

Dale, G. L. Mount Kisco. Caryomyia caryae O. S., gall on hickory, July 22

Rooney, Mrs J. O. Scarsdale. Same as preceding, July 24. Also Caryomyia persicoides Beutm.

Albright, Thomas. New Baltimore. Contarinia pyrivora Riley, pear midge, larvae on pear, May 27

Baker, C. F. Claremont, Cal. Asphondylia betheli Ckll., male, female, larva and pupa on Opuntia, April

Bethel, E. Denver, Col. Same as preceding, gall, male and female on Cactus, May 22

Rhines, W. D. Linlithgow. Simulium sp., blackfly, larvae, June 19

Bernstein, Charles. Rome. Eristalis tenax Linn., bee fly, larvae, August 27

Gillett, J. R. Kingston. Musca domestica Linn., housefly, larvae from cases of Myiasis interna, September 9

Amundsen, E. O. San Diego, Cal. ?Agromyza sp., adult on Wisteria buds, March 23

Lepidoptera

Principal, Schoharie High School. Schoharie. Through State Department of Agriculture. Polygonia ? comma Harr., hop merchant, eggs on hop, June 5

Delafield, Mrs I. D. F. Greenport. Euvanessa antiopa Linn., spiny elm caterpillar, larva on elm, June 25

Sweigert, J. A. Comstock. Same as preceding, July 1

Dodge, J. H. Rochester. Sphecodina abbotii Swain, larva on woodbine, July 10

Dummett, Arthur. Mount Vernon. Same as preceding, July 29

De Long, E. W. Crown Point. Ampelophaga myron Cram., grapevine hog caterpillar, larva on grape, August 7

Gaut, H. Glen Cove. Samia cecropia Linn., Cecropia moth, cocoon, December 28

Jackson, Mrs A. M. A. Warner. Telea polyphemus Cram., American silk worm, eggs, June 6

Wilbor, Miss M. R. Old Chatham. Callosamia promethea Dru., Promethea moth, cocoons, May 10

Martin, Mrs Martha W. Albany. Same as preceding, larvae on lilac, August 5

Worman, A. E. Fillmore. Through State Conservation Commission. Diacrisia virginica Fabr., Virginia ermine moth, adult, June 20

Strickland, L. F. Lockport. Through State Department of Agriculture. Arctia caja Linn., garden tiger moth or woolly bear of Europe, larva, October 26

Woolworth, C. C. Castleton. Alypia octomaculata Fabr., eight-spotted forester, larva on woodbine, July 10

Mostow, Robert. New York City. Laphygma frugiperda Sm. & Abb., fall army worm, larvae and pupae on lawn, September 11

Latham, Roy. Orient Point. Same as preceding, September 11

Parsons, Samuel. New York City. Same as preceding, September 11 and 21

Niles, T. F. Chatham. Agrotis ypsilon Rott., black cutworm, larva, June 10

Rogers, F. E. Oswego. Mamestra picta Harr., zebra caterpillar, larvae on pear, July 16

Bird, Henry. Rye. Papaipema appassionata Harvey, P. necopina Grt., P. frigida Sm., P. sciata Bird, P. inquaesita G. & R., P. maritima Bird, P. rigida Grt., P. marginidens Gn., P. moeseri Bird, P. duplicata Bird, P. cerussata Grt., P. duovata Bird and Apamea erepta var. graminea Bird, August 14

Bailey, G. W. Geneseo. Alabama argillacea Hübn., cotton moth, adults, October 9

Mosher, H. J. New Berlin. Same as preceding, October 11

Bishop, I. P. Buffalo. Same as preceding, October 13

Green, A. H. Shushan. Catocala sp., caterpillar, June 19

Richardson, M. T. New York City. Datana integerrima Grt. & Rob., black walnut worm, larvae on English walnut, August 5

Smith, C. H. Mohegan Lake. Same as preceding, caterpillars, August 22

Wiltse, J. W. North Chatham. Schizura concinna Sm. & Abb., red-humped apple caterpillar, larvae on apple, July 9

Dodge, J. H. Rochester. Tolype laricis Fitch, larch lappet moth, larva, August 8

Coventry, T. L. Utica. Malacosoma americana Fabr., apple tent caterpillar, larvae, June 12

Matthews, P. B. Bridgehampton. Through State Department of Agriculture. Same as preceding, larvae on oak, June 19

Whitcomb of The Commonweal. Greenwich. Same as preceding, adult, July 7

Chahoon, George. Ausable Forks. Same as preceding, cocoons, July 13

Hicks, Isaac & Son. Westbury. Malacosoma disstria Hübn., forest tent caterpillar, larvae, June 10

Worman, A. E. Fillmore. Through State Conservation Commission. Same as preceding, larvae, June 20

Vosburgh, G. C. Moravia. Eranis tiliaria Harr., basswood inch worm, larvae on elm and basswood, June 8

Brown, Miss Helen A. Brooklyn. Thyridopteryx ephemeraeformis Haw., bagworm, larvae on purple beech, August 2

Felten, G. R. Cementon. Sibine stimulea Clem., saddleback caterpillar, September 3

Mulholland, J. B. Kingston. Same as preceding, larvae on blackberry, September 24

Hicks, Isaac & Son. Westbury. Zeuzera pyrina Linn., leopard moth, work on hickory, October 26

Mulligan, E. T. New York City. Through State Department of Agriculture. Same as preceding, larva, December 24 and 27

Lobdell, Miss Mary L. Woodhaven. Same as preceding, larva, March 17

St John, C. L. Canajoharie. Mineola indigenella Zell., leaf crumpler, larval cases, February 24

Stevens, Ogden. Albany. Ephestia cautella ? Walk., larvae and adults on English walnuts, November 20

Smith, W. F. Valhalla. Evetria ? frustrana Comst., caterpillar on pine, August 30

Fernald, H. T. Amherst, Mass. Evetria ? comstockiana Fernald, pitch twig moth on pine, June 12

Scofield, R. Coeymans. Tmetocera ocellana Schiff., bud moth, larvae in pear buds, May 8

Emmons, G. E. Schenectady. Tortrix fumiferana Clem., spruce bud moth, larvae on spruce, June 3

Weld, F. M. New York City. Coleophora caryaefoliella Clem., larvae and work on hickory, July 13

Evans, Cadwallader. Stellarton, Nova Scotia. Bucculatrix canadensisella Cham., birch leaf skeletonizer, molting cocoons, August 29. Also larvae, cocoons and work on birch, September 18

Harrison, David. Staatsburgh. Phyllonoryter hamadryella Clem., oak blotch leaf miner, mines on oak, July 29

Wier, Miss Anne R. Garrison. Same as preceding, work on oak August 5

Clark's Sons, D. Fordam Heights, New York City. Through State Department of Agriculture. Gracilaria near violacella Busck, larvae on azalea, March 7

Neuroptera

Nixon, I. L. Rochester. Corydalis cornuta Linn., horned Corydalis, adult, July 1

Thysanoptera

Ward, G. E. Ravena. Euthrips pyri Dru., pear thrips, adults on apple, May 1

Hemiptera

Bailey, G. A. Geneseo. Tibicen septendecim Linn., seventeen-year Cicada, adult and pupal case, June 14

Dodge, J. H. Rochester. Cicada ? linnei Grossb., harvest fly, adult, August 26

Buchholz, A. B. Geneva. Through State Department of Agriculture. Phylloxera caryaecaulis Fitch, hickory gall aphid, old galls on hickory, October 26

Armer, H. N. Ballston Spa. Through State Conservation Commission. Chermes pinicorticis Fitch, pine bark aphid, adults on pine, July 5

Judson, W. P. Broadalbin. Same as preceding, July 12

Duhamel, M. F. Poughkeepsie. Same as preceding, August 8

Baker, A. M. Oneonta. Hormaphis hamamelidis Fitch, witch-hazel cone gall, galls on witch-hazel, August 5

Banks, Mrs R. S. Albany. Pemphigus populi-transversus Riley, gall and young on poplar, June 18

Olsen, C. E. Maspeth, L. I. Schizoneura americana Riley, woolly elm leaf aphis, young on elm, June 18

Hareford, Miss Alice C. Watertown. Same as preceding, adults and young on elm, June 21

Fuller, A. R. Malone. Same as preceding, adults and work on elm, July 18

Niles, Mrs S. H. Coeymans. Schizoneura lanigera Hausm., woolly apple aphis, young on apple, November 8

Delehanty, J. A. Albany. Same as preceding, nymph on apple, August 26

Marshall, D. T. Hollis. Chaitophorus aceris Linn., work and young on Norway maple, July 6

Gibson, W. W. Watervliet. Same as preceding, nymphs on Norway maple, July 11

Waterman, R. S. Ogdensburg. Callipterus ulmifolii Mon., elm leaf aphis, adults on elm, July 1

Barrus, G. L. Paul Smiths. Mindarus abietinus Koch., work on balsam, July 1

Latham, Roy. Orient Point. Aphis nasturtii Kalt., adults and nymphs on nasturtium, October 3

Brock, J. G. Binghamton. Gossyparia spuria Mod., elm bark louse, males and females on elm, May 29

Cockerell, T. D. A. Boulder, Col. Eriococcus borealis Ckll., adults, October 7

Hessberg, Samuel. Albany. Phenacoccus acericola King, false maple scale, males on maple, June 11

Cockerell, T. D. A. Glenwood Springs, Col. Trionymus violascens Ckll. (part of type), adult on Agropyron, October 2

Olsen, C. E. Maspeth. Pseudococcus citri Risso, mealy bug, adult, July 20

Marshall, D. T. Hollis. Pulvinaria vitis Linn., cottony maple scale, adults and young on soft maple, July 6

Tioga county. Through State Department of Agriculture. Lecanium sp., Lecanium scale, adult and young on Tecoma radicans, November 1

Carpenter, E. E. Morris. Same as preceding, adults on oak and chestnut, June 8

Woodlawn Cemetery. New York City. Through State Conservation Commission. Asterolecanium variolosum Ratz., golden oak scale, adult, June 14

Livingston, J. H. Tivoli. Toumeyella liriodendri Gmel., tulip tree scale, young on tulip tree, February 12

Harris, A. G. North Pelham. Same as preceding, adults on tulip, July 29

Thomson, Miss Annis E. Yonkers. Same as preceding, July 29

Clark, S. M. Warrensburg. Eulecanium ? canadense Ckll., adults on elm, May 27

Van Aken, Silvanus. Port Ewen. Eulecanium ? persicae Fabr., peach scale, adults and eggs on crimson rambler rose, June 17

Lown, Mrs Robert. Idlewild. Same as preceding, July 2

Heavey, J. Buffalo. Chionaspis furfura Fitch, scurfy scale, eggs, March 5

Levison, J. J. Brooklyn. Chionaspis americana Johns., elm scurfy scale, egg on elm, February 6. Also Chionaspis pinifoliae Fitch, pine leaf scale, egg on Austrian pine, February 6

Duff, Mrs Harriet A. Kinderhook. Chionaspis pinifoliae Fitch, adults on pine, September 16

Through State Department of Agriculture. Rochester. Diaspis carueli Targ.-Tozz., juniper scale on juniper, May 16

Heavey, J. Buffalo. Aspidiotus perniciosus Comst., San José scale, young, March 5

Williams, C. L. Glens Falls. Same as preceding, May 24

Stone, D. D. Oswego. Aspidiotus ancylus Putn., Putnam's scale, half grown, April 19

Latham, Roy. Orient Point. Chrysomphalus aonidum Linn., rubber scale insect, adults on rubber plant, April 22

Gaut, H. Glen Cove. Lepidosaphes ulmi Linn., oyster shell scale, egg on willow, December 28

Heavey, J. Buffalo. Same as preceding, eggs, March 5

Henkes, Fred. Watervliet. Through State Department of Agriculture. Same as preceding, old scales on apple, May 11

Hasbrouck, Levi. Ogdensburg. Same as preceding, June 22

Olsen, C. E. Maspeth. Same as preceding, adults on white birch, July 20

Through State Department of Agriculture. Schenectady. Parlatoria theae Ckll., adult on Japanese maple, April 25

Overton, Miss Lillian C. Albany. Haematopinus piliferus Burm., sucking dog louse, adults on dog, April 8

St John, C. L. Canajoharie. Blissus leucopterus Say, chinch bug, adults and young, September 26

Buchman, Edwin. Valley Falls. Acholla multispinosa DeG., spined assassin bug, nymph, August 13

Briggs, G. J. Macedon. Cimex lectularius Linn., bedbug, adult, May 12

Williams, C. L. Glens Falls. Lygus pratensis Linn., tarnished plant bug, work on dahlia, July 17

Strickland, L. F. Lockport. Poecilocapsus lineatus Fabr., four-lined leaf bug, adults on currant, June 19

Latham, Roy. Orient Point. Benacus griseus Say, giant water bug, adult, June 10

Orthoptera

Dummett, Arthur. Mount Vernon. Diapheromera femorata Say, walking-stick, adult, August 20

Thysanura

Stagg, J. E. Buffalo. Through State Department of Agriculture. *Lepisma domestica* Packard, silver fish, adult, October 25

Acarina

Osterhout, G. E. Windsor, Col. *Eriophyes pruni* Schoene, plum mite, galls on plum, July 22

Herrick, G. W. Ithaca. *Phyllocoptes quadripes* Shimer, bladder maple gall, galls on soft maple, June 11

Babcock, H. N. Elmira. Same as preceding, June 24

ZOOLOGY

Donation

Mammals

Paine, Silas H. Silver Bay

Red squirrel, *Sciurus hudsonicus* (Erxleben)..... 3

Birds

Rensselaer Polytechnic Institute, Troy

Dowitcher, *Macrorhamphus griseus* (Gmelin) 1

Hudsonian godwit, *Limosa haemastica* (Linnaeus) 1

Sharp-shinned hawk, *Accipiter velox* (Wilson).... 1

Pigeon hawk, *Falco columbarius* (Linnaeus).. 1

Ivory-billed woodpecker, *Campephilus principalis* (Linnaeus) 1

Prairie hen, *Tympanuchus americanus* (Reich.). 1

Sanford, Dr Leonard S. New Haven, Conn.

Old squaw, *Harelda hyemalis*..................... 1

Birds' nests

Delavan, Dr C. H. Round Lake

Baltimore oriole, *Icterus galbula* (Linnaeus)...... 1

Red-eyed vireo, *Vireosylva olivacea* (Linnaeus). 1

Fishes

Bean, Dr Tarleton H. Albany

Dace, *Semotilus bullaris* (Rafinesque)......... 1

Invertebrates

Casselman, E. S. Lake Delaware

Copepods, Cyclops strenuus Fischer............ 1 lot

Peck, H. S. Menands

Spider, Lycosa carolinensis, Walckenaer, female and eggs.................................. 1

Cass, Allan. Albany

Slug, Limax maximus, Linnaeus.................. 1

Bean, Dr Tarleton H. Albany

Fresh-water clams, Unionidae...................... 2 lots

Exchange

Fresh-water and land shells

Baker, H. B. Ann Arbor, Mich.

Goniobasis livescens (Merke)
Campeloma decisum (Say)
Valvata sincera (Say)
Amnicola limosa (Say)
Vitrea ferrea (Morse)
Cochlicopa lubrica (Müller)
Strobilops virgo (Pilsbry)
Succinea retusa (Lea)
Lymnaea emarginata (Say)
Lymnaea emarginata angulata (Sowerby)
Lymnaea stagnalis appressa (Say)
Lymnaea stagnalis perampla (Walker)
Physa ancillaria magnalacustris (Walker)
Physa ancillaria parkeri (Currier)
Aplexa hypnorum (Linnaeus)
Planorbis hirsutus (Gould)
Planorbis bicarinatus portagensis (Baker)
Planorbis campanulatus smithii (Baker)
Planorbis bicarinatus (Say)
Segmentina crassilabris (Walker)
Sphaerium sulcatum (Lamarck)
Sphaerium acuminatum (Prime)
Pisidium abditum (Haldeman)
Pisidium abditum subrotundum (Sterki)
Pisidium regulare (Prime)
Lampsilis luteola (Lamarck)
Lampsilis nasuta (Say)

Anodonta grandis footiana (Lea)
Anodontoides l'erussaciana subcylindricacea (Lea)

Purchase

Mammals

Barker, Fred. Parker's Prairie, Minn.
Weasel, Mustela cicognani Bonaparte.......... 1
Mole, Scalopus aquaticus (Linnaeus).......... 1
Ward's Natural Science Establishment, Rochester
Common dolphin, Delphinus delphis Linnaeus, cast 1

Birds

Barker, Fred. Parker's Prairie, Minn.
Holboell grebe, Colymbus holboelli (Reinhardt).. 1
Ring-billed gull, Larus delawarensis Ord........ 2
Bonaparte gull, Larus philadelphia (Ord)...... 1
Common tern, Sterna hirundo Linnaeus.......... 3
Black tern, Hydrochelidon nigra surinamensis (Gmelin) 2
White pelican, Pelecanus erythrorhynchos Gmelin 1
Virginia rail, Rallus virginianus Linnaeus....... 2
Stilt sandpiper, Micropalma himantopus (Bonaparte) 1
Semipalmated sandpiper, Ereunetes pusillus (Linnaeus) 2
Lesser yellowlegs, Totanus flavipes (Gmelin)..... 2
Black-breasted plover, Squatarola squatarola (Linnaeus) 3
Killdeer plover, Oxyechus vociferus (Linnaeus). 2
Ring-necked plover, Aegialitis semipalmata (Bonaparte) 2
Brown, Wilbur. Albany.
Barred owl, Strix varia Barton.......... 1
Danygriz, Mathew. Albany
Sora, Porzana carolina (Linnaeus).......... 1
Yellow rail, Coturnicops noveboracensis (Gmelin) 1
Wilson phalarope, Steganopus tricolor (Vieillot). 1

Avocet, Recurvirostra americana Gmelin...... 1
Stilt sandpiper, Micropalma himantopus (Bonaparte) 1
Least sandpiper, Pisobia minutilla (Vieillot)..... 1
Marbled godwit, Limosa fedoa (Linnaeus)...... 1
Willet, Catoptrophorus semipalmatus (Gmelin) 1
Upland plover, Bartramia longicauda (Bechstein) 1
Buff-breasted sandpiper, Tryngites subruficollis (Vieillot) 1
Spotted sandpiper, Actitis macularius (Linnaeus) 2
Long-billed curlew, Numenius americanus Bechstein 1
Golden plover, Charadrius dominicus Müller.... 4
Turnstone, Arenaria interpres (Linnaeus)..... 1
Rough-legged hawk, Archibuteo lagopus sancti-johannis (Gmelin).................. 1
Great horned owl, Bubo virginianus (Gmelin).. 1
Pileated woodpecker, Phloeotomus pileatus (Linnaeus) 2
Redpoll linnet, Acanthis linaria (Linnaeus)........ 2
White-crowned sparrow, Zonotrichia leucophrys (Forster) 1

Sanderson, W. Rensselaer

American scoter, Oidemia americana (Swainson and Richardson) 2

Birds' nests and eggs

Hart, C. G. East Berlin, Conn.

Red-shouldered hawk, Buteo lineatus (Gmelin), nest and three eggs.

Cooper hawk, Accipiter cooperi (Bonaparte), nest and four eggs.

Reptiles

Ward's Natural Science Establishment, Rochester

Harp turtle, Dermochelys coriacea (Vandelli) cast 1

Amphibia

Ward's Natural Science Establishment, Rochester

Common tree toad, Hyla versicolor Le Conte, casts. 3

ARCHEOLOGY

Donation

Auringer Collection, donated by Dr Albert Vander Veer

Quartz spear	1
Arrow points, stone	180
Stone hoes	6
Spears	28
Hammers	30
Cache of flints	40
Pestles, roller	6
Metates	4
Slate knives, Esquimeaux	4
Steel lance head	1
Beads, 1 string	1
Pitted stones	20
New sinkers	102
Worked stones	184
Notched axes	12
Celts	54
Pottery fragments	52
Pot stone, worked fragments	21

Bird, Daniel. Troy

Skull and fragments of skeleton	1

Burmaster, E. R. Irving

Mound skull	1
Pottery fragments	4
Stone celt	1
Crude celt	1
Hammer stones	1

Holden, Hon. J. A. Glens Falls

Cylindrical pestle	1

Hurd, A. S. Troy

Specimen fine semilunar knife	1
Specimen scraper	1
Fragments pottery	10

Purchase

Tann, Mrs Charles. Troy

Triangular flints	16
Arrow points	71
Spears	16
Leaden effigy of tomahawk	1

Kopple, Pauline. New York
Carved wooden crucifix.............................. 1
Schmits
Baskets.. 3
Nicholson, A. S. Neopit, Wis.
Bark house..................................... 1
Bradly, E. R. Cazenovia
Grooved shaft stone............................ 1

Collection in the field

Parker, A. C.
Algonquin bark hamper.......................... 1
Brass medal.................................... 1
Wooden spoons.................................. 2
Seneca mask.................................... 1
Stone hatchet.................................. 1

THE MOUNT MORRIS METEORITE

BY H. P. WHITLOCK

The State Museum has recently acquired by purchase a meteoric fragment which represents a hitherto unrecorded fall, and adds another occurrence to the small number of authenticated meteorites from New York State.

The specimen was found in December 1897 by Mr Frederick H. Crofoot, on the Landers farm about one and one-half miles south of Mount Morris, Livingston county, N. Y. It measures 30 mm x 20 mm x 13 mm and weighs 12.48 grams. The shape roughly suggests a rhomboidal solid similar to a distorted rhombic-dodecahedron, although this rough shape has in all probability no significance and is purely accidental. One side has been roughly polished, showing the structure.

The structure classification which was determined as nearly as possible macroscopically, places this meteorite in the group Chondrites, the ground mass being composed of spherulitic chondrules of enstatite and olivine of irregular sizes. The ground mass is broken by irregular shotlike grains of iron.

Notwithstanding the small size of the specimen, all the evidence appears to confirm the statement of Mr Crofoot that the present fragment represents the entire bulk of this fall.

Figure 1 gives a full-size view of the meteorite, showing the general shape and character of the surface. Figure 2 shows the polished surface of one side; the brilliantly reflecting portions of the surface are the iron particles included in the ground mass.

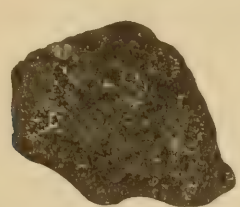


Fig. 1 Full-size view showing general shape and character of the surface

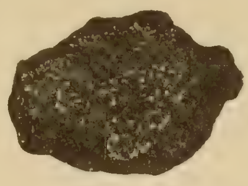


Fig. 2 Full-size view showing polished surface of one side

The following list gives the authenticated meteorites which have been found in New York State.

LOCALITY OF FALL	REPRESENTED IN N. Y. STATE MUS. COLL.	DATE OF DISCOVERY	PUBLISHED ACCOUNT	AUTHOR
Bethlehem, Albany co....	×	aAug. 11, 1859	Am. Jour. Sci. (2). *28*:300.	C. V. Shepard
Burlington, Otsego co.....	×	Previous to 1819	Am. Jour. Sci. (1). *46*:401	James Pierce
Long Creek, Jefferson co..	....	....	In British Museum Coll...	....
Lockport, Niagara co.....	....	1818	Am. Jour. Sci. (1). *48*:388.	B. Silliman
Mount Morris, Livingston co....................	×	1897	....	....
Scriba, Oswego co........	×	....	Am. Jour. Sci. (1). *40*:336.	C. V. Shepard
Seneca Falls, Seneca co....	....	....	Am. Jour. Sci. (2). *2*:39..	C. V. Shepard
Seneca River, Cayuga co..	....	....	Am. Jour. Sci. (2). *14*:439.	E. W. Root
Tomhannock, Rensselaer co....................	×	....	Am. Jour. Sci. (3). *34*:60..	Bailey
Yorktown, Westchester co.	....	....	....	....

a Observed fall.

EARLY PALEOZOIC PHYSIOGRAPHY OF THE SOUTHERN ADIRONDACKS

BY WILLIAM J. MILLER

INTRODUCTION

For many years the problem of the early Paleozoic physiography of the Adirondack region has been an important one to all interested in the geological history of northern New York. Observations made during the past ten or fifteen years have thrown much light upon this problem, especially significant being the work of Cushing, Kemp, Ruedemann, and Ulrich. For some years the writer also has been studying the geology of the southern Adirondacks, the five quadrangles which he has mapped in detail all having important bearings upon the subject. It is the purpose of this paper to bring together old and new observations in an attempt to reconstruct the major physiographic features of the southern Adirondack region during the Cambric and Ordovicic periods. The Black river, Mohawk and Champlain valleys will be discussed only in so far as facts from those regions have a direct bearing upon the problem. Since the Paleozoic rock outliers in the southeastern Adirondacks are particularly significant in this connection, they will be duly emphasized.

Some of the principal questions discussed are the following:

1 What was the character of the surface of the Precambric rock upon which the early Paleozoic sea encroached?

2 Were the early Paleozoic sediments deposited in embayments of the sea extending into the Precambric rock area or did they form a more general mantle over the Precambric rocks?

3 Was the southern Adirondack region ever completely submerged during the Paleozoic era and, if so, when?

4 Where were the principal land areas located during the Cambric and Ordovicic periods?

5 Does the present northeast-southwest main axis of elevation through the Adirondacks also have an early Paleozoic significance?

CAMBRIC PHYSIOGRAPHY

The Cambric peneplain. As is well known, the whole Adirondack region was above water and undergoing erosion during the early and middle Cambric. This is proved by the total absence of the early and middle Cambric strata and also because there is not the slightest evidence that any such strata ever were deposited over the region. Furthermore there is every reason to believe that this important erosion interval was inaugurated long before the opening of the Paleozoic era. As a result of this vast erosion the whole Adirondack region had, by the opening of Potsdam (late Cambric) time, become worn down to the condition of a more or less well-developed peneplain.

As will be shown below, the distribution of the strata proves that the northeastern and eastern borders of the Adirondacks sank below sea level first in early Potsdam time; then the southeastern and southern portions in late Potsdam, Theresa and Little Falls times; and last the southwestern border well along in Ordovicic (Pamelia) time.

The peneplain surface of the Precambric rock under the Paleozoic strata has been carefully studied on all sides of the Adirondacks and it has been fully demonstrated that it is roughest along the northeastern and eastern sides; less rough along the southeastern and southern sides; and very smooth along the southwestern side. Even where roughest the differences of elevation never amount to more than a few hundred feet, while on the southern side Cushing[2] and the writer[10] have each found knobs or ridges of hard Precambric rock projecting upward from fifty to eighty feet into the Cambric strata, though these appear to be extreme cases of ruggedness of the surface of the peneplain. Along the southwestern border of the Adirondacks the writer has shown by his mapping of the Port Leyden quadrangle[9] that the surface of the peneplain is there remarkably smooth. This increasing smoothness of the peneplain from northeast to southwest is precisely what would be expected because the southwestern side of the Adirondacks remained dry land much the longest time. In the eastern Adirondacks Kemp[6]

[2] Page 57–58. The footnote numbers refer to the numbered references given in the list at the end of this paper.

[10] Page 51.

[9] Pages 40–41.

[6] Pages 408–12.

has argued that the major relief features immediately prior to the advent of the Potsdam sea were valleys carved out along the belts of weaker Grenville strata, especially the limestones.

Positive evidence regarding the physiographic condition of the interior Adirondack region during Cambric time is of course lacking, but there is no reason whatever for thinking that it was essentially different from the immediately surrounding regions except probably that the general altitude was somewhat greater.

Encroachment of the late Cambric sea. Cushing[3] has proved that the Potsdam sea encroachd upon the Adirondack region from the northeast toward the southwest because the sandstone formation of that age progressively thins from a thickness of over one thousand feet to disappearance in the southwest. During the encroachment of this late Cambric sea, did the waters enter distinct embayments or estuaries as Kemp[6] has suggested or did they form a more regular shore line? Along the eastern side, where the topography was moderately rugged, such embayments were quite likely physiographic features of some importance due to a drowning of the valleys which had been cut out along the belts of weaker Grenville strata. In the southern Adirondacks, however, the evidence is decidedly against the encroachment of the late Cambric sea by setting up anything like well-defined embayments or estuaries extending into the area of Precambric rock.

The outliers of Palezoic rock in the southeastern Adirondacks are of first importance in this connection. All the definitely known outliers well within the Precambric rock area of this region are given in the following list:

1 A small exposure of Potsdam sandstone near the southwestern corner of the Elizabethtown quadrangle and near the village of North Hudson.

2, 3, 4 Three outliers of Potsdam sandstone along the eastern side of the Paradox Lake quadrangle.

5 The Little Falls dolomite outlier (probably with underlying Potsdam) at Schroon Lake village, Schroon Lake quadrangle.

6 A small outlier of Potsdam sandstone one and one-half miles west of the village of North River in the northeastern corner of the Thirteenth Lake quadrangle.

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[3] Pages 279–80.
[6] Pages 408–12.

7 A small outcrop of Theresa sandstone and dolomite (probably with underlying Potsdam) near the northern border of the Luzerne quadrangle and one mile due west of High Street village.

8 The outlier in the Sacandaga valley at Wells, Lake Pleasant quadrangle. This, the largest and most interesting of all the outliers, shows Potsdam sandstone, Theresa transition beds, Little Falls dolomite, Black River (Lowville) limestone, Trenton limestone, and Canajoharie (Trenton) shale.

9 An outlier showing Theresa beds, Little Falls dolomite, and Black River limestone in the Sacandaga river valley of the Lake Pleasant quadrangle and between one and three miles northwest of Hope postoffice.

Of these, numbers 7 and 9 have been discovered by the writer within the past three years.

Besides the above there are a number of other outliers close to the main body of Paleozoic strata as: In the valley one and one-half miles west of Northville (Broadalbin quadrangle) and including Potsdam, Theresa and Little Falls strata; several Potsdam sandstone outliers within the tongue of Precambric rock lying just east of Lake George; and several others in the northwestern portion of the Ticonderoga quadrangle.

Wherever detailed geologic maps have been recently made in the southeastern Adirondacks the region is shown to be literally cut to pieces by numerous normal faults, as many as fifteen to thirty being clearly recognizable within single quadrangles. Most of the prominent faults strike northeast-southwest with throws usually ranging from a few hundred to two thousand or more feet. It is important to note that all the outliers above mentioned as occurring well within the Precambric rock area, except possibly those of the Paradox Lake quadrangle, lie on the downthrow sides of such faults. In the case of the Wells outlier (No. 8) the valley is of the nature of a " graben " or fault-trough with a prominent fault on each side so that the block of Paleozoic rock has been dropped down no less than sixteen hundred feet to its present position. Thus there appears to be no escape from the conclusion that the valleys containing these outliers have been largely produced by faulting and that the Paleozoic strata formerly lay at a much higher level, that is, the general level of the Precambric rock surface.

It should be pointed out that the possible exceptions in the cases of the outliers along the eastern side of the Paradox Lake quadrangle, as well as those of the Ticonderoga quadrangle and to the east of Lake George, all lie close to the general Paleozoic rock area and in that portion of the southern Adirondacks upon which the late Cambric sea first encroached and where the topography was most rugged so that it is quite possible that local embayments receiving Cambric sediments did there exist.

In the cases of all the other and important outliers there does not appear to be any direct evidence favoring the existence of embayments nor any need for such an explanation to account for the phenomena of the outliers. Simple downfaulting of the Paleozoic strata has often carried masses of these so far down that remnants have been protected from complete removal by subsequent erosion. As already shown the southern Adirondack region was, by the beginning of the Potsdam, worn down to a peneplain upon whose surface only a few very minor irregularities existed. This being the case, anything like prominent embayments or estuaries could not possibly have existed. Another argument decidedly against the embayment idea comes out of the character of the sediments within the outliers. Thus the dolomite in the Schroon Lake and Wells outliers is a distinctly marine formation of exactly the same character as that of the general Paleozoic rock area. Or again, the Canajoharie black shale at Wells is both faunally and lithologically distinctly marine and precisely like that of the Mohawk valley. Estuarine deposits would show certain distinct local variations and hence the very uniformity of sediments in the outliers precludes the possibility of deposition in estuaries. Thus we are forced to conclude that when the early Paleozoic sea encroached upon the southern Adirondacks, the shore line was fairly regular, with possibly some very small local embayments along the eastern side, and that a general mantle of sediments was deposited over the whole southeastern Adirondack region.

Extent of the Cambric seas. Nearly all the Paleozoic outliers show the presence of Potsdam sandstone, and in the few cases where it does not actually outcrop it is most likely present though concealed from view. In the southern Adirondacks no Potsdam sandstone outcrops west of a nearly straight northeast-southwest line passing through the outliers at or near North Hudson (No. 1), North River (No. 6), Wells (No. 8), and

through the village of St Johnsville in the Mohawk valley. Thus we are certain that the shallow Potsdam sea overspread practically the whole southern Adirondack region east of this line except for a few local knobs or ridges of hard Precambric rock which remained above the sea level. A fine example of such a local projection above the Potsdam sea level has been described by the writer[10] in his report on the Broadalbin quadrangle. That the Potsdam shore line extended a short but unknown distance farther west than Wells and North River is certain because a considerable thickness of sandstone is still represented at those places. This conclusion regarding the position of the Potsdam shore line is in harmony with the statement of Ulrich and Cushing[16] when they say: "It is thought that along the Mohawk line the Potsdam shore had a southwesterly trend more to the south than the present Precambric margin, the two meeting at an angle; east of the meeting point the Potsdam appears under the Little Falls, while west of it the Potsdam is either absent or erosion has not yet cut down to it."

That the southwestern Adirondacks were not submerged under the Potsdam sea is proved by the complete absence of the sandstone from the southwestern border; the very character of the sediments (sands and pebbles) which demands nearness to a mass of Precambric rock; and the negative evidence from the fact that no outliers of Potsdam have ever been found in this region. The Potsdam sea did extend up the St Lawrence valley as shown by the presence of the sandstone there.

Thus we conclude that a long, low, land area of Precambric rock extended in a northeast-southwest direction through the Adirondack region, and that this height of land in Potsdam time had almost exactly the same position as the present main axis of elevation of the mountains.

Since the Potsdam sandstone grades into the succeeding, alternating sandstone and dolomite beds of the Theresa and the two formations have almost precisely the same distribution, we are safe in asserting that the physical geography conditions of Theresa time were essentially like those of Potsdam time except that the southeastern Adirondacks were then even a little more submerged.

The distribution of the Little Falls dolomite which succeeds the Theresa beds without unconformity along the southern and

[10] Pages 51–52.
[16] Page 139.

southeastern border of the Adirondacks and in the outliers at Schroon Lake and Wells shows that the Little Falls sea extended over at least as much of the southern Adirondacks as did the Potsdam-Theresa seas. In the Mohawk valley region it extended considerably farther westward overlapping upon the Precambric rock to the southwest corner of the Wilmurt quadrangle where the dolomite thins out to disappearance. From this point northwestward the Precambric rock margin shows no dolomite, thus proving the absence of the Little Falls sea there. The very rapid decrease in thickness of the dolomite from four hundred feet at Little Falls to complete disappearance just beyond the northern boundary of the Little Falls quadrangle also shows the limit of the sea in that district. Accordingly there must have been a large land mass in the southwestern Adirondack region. The very presence of so many sand grains in the dolomite (giving rise to the old name Calciferous sandrock) requires that it was deposited comparatively near a land mass. Thus during late Little Falls time the eastern portion of the southern Adirondacks was submerged while the western portion remained dry land, the shore line extending from the southwest corner of the Wilmurt quadrangle most probably in a northeasterly direction through the southern Adirondacks. That its shore line was, in general, a little farther westward than that of the Potsdam sea is strongly suggested by the fact that all the Cambric sediments were gradually accumulated in a downsinking trough occupying the southeastern Adirondack area. This idea of a gradual westerly encroachment of the Cambric sea is borne out by the following facts: The thickness of the Cambric section within the Saratoga quadrangle is from four hundred to five hundred feet; within the Broadalbin quadrangle near Northville four hundred to four hundred and fifty feet; and at Wells about two hundred feet. This rapid decrease in thickness of two hundred feet from Northville to Wells within a distance of fourteen miles shows a westward to northwestward encroachment of the Cambric sea and that the downward slope of the surface here receiving Cambric sediments was fourteen feet a mile toward the southeast.

According to Ulrich and Cushing[16] there is a distinct stratigraphic break represented by a notable erosion unconformity at the top of the Little Falls dolomite. Thus all available evidence supports the idea that, by the close of the Cambric period, subsidence

[16] Page 129.

ceased and the whole southern Adirondack region was raised above sea level and underwent erosion. The western portion of this land area was of Precambric rock while the surface rock in the eastern portion was Little Falls dolomite.

To summarize for the Cambric period: All evidence is decidedly against a complete submergence of the southern Adirondack region during the late Cambric period, the land mass of the time having occupied at least all of Hamilton county except its southeastern portion; all the northern half of Herkimer county; and most of the eastern portion of Lewis county. This axis of elevation most likely continued northeastwardly through the Adirondack region to its northeastern portion and occupied about the same area as the present main axis of elevation of the mountains. The close of the Cambric witnessed an uplift sufficient to convert the whole southern Adirondack region into dry land.

ORDOVICIC PHYSIOGRAPHY

Early Ordovicic. According to Ulrich and Cushing[16] the Tribes Hill limestone is the earliest Ordovicic formation. Its distribution demonstrates that the Mohawk valley to a little northwest of Little Falls and the lower Black river valley were submerged. Its total absence from the southwestern Precambric boundary, from the outlier at Wells, and from the vicinity of Northville and Saratoga Springs strongly suggests that little if any of the southern Adirondack region was submerged under the Tribes Hill sea. This limestone is probably not present in the Champlain valley but, if it is, a little of the eastern border of the Adirondacks may have been submerged. It would seem, therefore, that this Tribes Hill submergence was not as extensive as that of Little Falls time. After the deposition of the Tribes Hill limestone, however, there was a long erosion interval continuing to Black River time and hence because of removal of Tribes Hill limestone by this erosion it is more than likely that the present outcrops do not indicate the full extent of the Tribes Hill sea. At any rate there is not the slightest direct evidence for any considerable submergence of the southern Adirondack area at this time.

During the long interval between Tribes Hill and Black River times the whole southern Adirondack region was above sea level except locally along the western border for a short time when

[16] Pages 128–30.

the Pamelia (Chazy) limestone was being deposited in the Black river valley and also locally along the eastern border when certain other limestones of the Chazy group were being laid down in the Champlain trough.

For most part the various Black River limestone members are thin and patchy in their distribution except in the Black river valley, and no attempt is here made to enter into the details of physiography and oscillations of level in Black River time. Suffice it to say that early Black River (Lowville) limestone is present on all sides of the southern Adirondacks and in the outlier at Wells, it being but a few feet thick in the eastern and southern portions and fifty to sixty feet thick along the western border. Therefore, judging by the areal distribution and thinness of the Lowville we are practically certain that the central western portion of the Adirondack area was not submerged during early Black River time. Thin limestone deposits of late Black River age are confined to the vicinity of Watertown (Watertown limestone) and along the eastern and southeastern borders of the Adirondacks (Amsterdam limestone) with deposition in these two regions not occurring simultaneously. Thus there could not have been anything like extensive submergence of the southern Adirondacks in late Black River time.

The widespread unconformity at the summit of the Black River group of limestones shows that a general upward oscillation occurred and that the whole southern Adirondack region became dry land before the succeeding Trenton submergence.

Late Ordovicic. During Trenton time there was a widespread submergence of much of the southern Adirondack region as shown by the existence of Trenton limestone or shale hundreds of feet thick on all sides of the region and even in the outlier at Wells. The limestone is almost wholly confined to the western side, there being but a few feet of limestone at the base of the Trenton on the eastern side where thick shales (Canajoharie and Schenectady) comprise nearly the whole section.

Considering the thickness (about four hundred feet) of the Trenton limestone in the upper Black River valley and the slope of the surface[9] on which deposition occurred, the Trenton sea could not have extended more than forty miles eastward into the Adirondack area. If we consider deposition to have taken place in a distinctly downwarped trough, then the Trenton sea must have extended in

[9] Page 43.

considerably less than forty miles, and this is the most likely view. By a similar line of reasoning Cushing[2] has shown that the Trenton sea could not have reached more than ten miles north of the north boundary of the Little Falls quadrangle. The thickness of about three hundred feet of Trenton (mostly shale) in the outlier at Wells shows that the Trenton sea must have reached at least a few miles north and west of that locality. Pebbles of Precambric rock and grains of sand in the Trenton limestone at Wells, however, make the existence of near-by land (Precambric rock) practically a certainty as argued by Kemp.[7]

From the above statements we conclude that dry land existed in the region of southwestern Hamilton county and also most probably over all of northern Hamilton county. It is worthy of note that this Trenton land mass, with northeast-southwest trend, occupied the same region as the present belt of highest land in the southern Adirondacks, and also that this land mass, though now smaller, occupied the same position as that of late Cambric and early Ordovicic times. The absence of Paleozoic rock outliers west of a northeast-southwest line through Wells and North River at least affords interesting negative evidence in harmony with this view.

Regarding Utica and Postutica times the results of recent work are decidedly against submergence of the whole Adirondack region. Considering the great thickness of Paleozoic strata; the slope of the surface of the Precambric rock; and the existing altitudes within the Adirondacks, Walcott, Cushing and the writer have all been led to conclude that the late Ordovicic sea must have extended almost, if not quite, across the whole Adirondack area. Many years ago Walcott[17] said: "There was a practically conformable deposit of sediments against and over the area of the Adirondack mountains from early Cambric times to the close of the deposition of the Utica shales, except in the case of the unconformity by nondeposition between the Potsdam and the Chazy."

Later Cushing,[1] as a result of his studies along the northeastern border of the Adirondacks, said: "The basal Potsdam is found running up to an elevation of seventeen hundred fifty feet in the northern Adirondacks. With the relief of the region as it is now the deposition of the minimum thickness (four thousand feet) of

[1] Page 77.
[2] Page 61.
[7] Page 152.
[17] Pages 24–25.

the Paleozoic rocks assigned above on this Potsdam would leave none of the present peaks projecting above the general level." Again he stated:[3] "This submergence (Utica) apparently completely overswept the old Adirondack island, and that for the first time in its paleozoic history, with the possible exception of the latter part of the Trenton."

Still later the writer,[9] speaking of the Paleozoic sediments along the southwestern border of the Adirondacks, said: "This thickness (fourteen hundred feet) is great enough so that even after allowing for decreased thickness due to overlap and a possibly increased slope (receiving sediments) as the heart of the Adirondacks was approached, we seem to have here a strong argument in favor of the submergence of the region for many miles to the east and northeast of Port Leyden, so that by the close of the Lower Siluric (Ordovicic) the submergence extended to, or close to, the heart of the Adirondacks."

This line of reasoning, however, does not regard the possible importance of downwarping troughs of deposition. As already shown in this paper, such troughs of deposition clearly did exist from Potsdam through Trenton time and we have no good reason to doubt their existence during Utica and late Ordovicic time as well. In a recent paper Cushing[4] says: "As the evidence accumulates it points more and more strongly to deposit in downwarping troughs, in which large depth of deposit by no means implies extensive overlap on the shores. . . . Even when submerged at the same time, as in the Trenton, the deposits on the two sides (east and west) are so different both lithologically and faunally, as to indicate that the two basins had no very direct connection."

Some years ago Ruedemann,[14] by noting the parallel positions of the graptolites in the black shales at Wells, Dolgeville (Herkimer county), along Nine Mile creek near Trenton Falls (Oneida county), etc., proved the existence of a late Ordovicic ocean current across the southern side of the Adirondack region. The proof for the existence of such an ocean current by no means implies that it swept entirely across the whole Adirondack region, and hence we have here no argument for a complete submergence of the region at that time. In fact Ruedemann gives good reason for the belief

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[3] Page 285.
[4] Page 144.
[9] Page 43.
[14] Pages 367–91 and [15] Pages 75–81.

that this current which was a southerly to southwesterly one along the eastern side of the Adirondack region changed to a more westerly current along the southern side, and this is precisely what would be expected in the case of a current sweeping partly around a land mass occupying the central Adirondack area.

Further, the very recent work of Ruedemann shows that the shales of the lower Mohawk valley and Champlain valley which have always been regarded as of Utica age are, in reality, of Trenton (Canajoharie and Schenectady) age; that the Utica shale is wholly absent from those regions; and that there is no evidence of their ever having been deposited there. Hence any argument for the complete submergence of the Adirondacks during Utica time receives a serious setback.

In the Black River valley the Utica is followed without interruption by the Frankfort and Pulaski shales and sandstones. The combined thickness (about nine hundred feet) there of the Utica, Frankfort, and Pulaski clearly implies, even considering deposition in a downwarping trough, that the sea spread well over the western side of the southern Adirondack region. However, the very character of the Frankfort and Pulaski rocks, which contain so much sandstone, implies comparative nearness to land undergoing pretty rapid wear and more than likely this land mass, in part at least, lay in the same general region as that of earlier time. In the vicinity of Utica the Pulaski beds are missing, signifying dry land there during that time, while on the southern and eastern sides the only strata of Posttrenton age are the Indian Ladder beds of Albany county which are thought to correlate with the Frankfort beds and which signify local subsidence at that time for that region. The outlier at Wells furnishes no data for Posttrenton time because of the absence of any strata younger than Canajoharie age.

South of Utica there is an important stratigraphic break between the Oneida (Siluric) conglomerate and the underlying Frankfort (Ordovicic) shales. This unconformity is very distinct so that prior to the deposition of the Oneida the region around Utica was well above sea level and undergoing erosion. The only possible source of the pebbles in the Oneida formation would seem to have been an area of Precambric rock, more than likely situated in that same portion of the Adirondacks which never became submerged during the Cambro-Ordovicic periods. That this uplift, which began in the late Ordovicic, affected the region as far eastward as the Hudson valley, and that the land remained above sea level for a long time

is shown by the complete absence of the Oneida conglomerate and the nearly complete absence of the Clinton and Niagara formations from southern Herkimer county eastward. Such a widespread and important elevation of the land in the Mohawk valley region almost certainly upraised the whole southern Adirondacks except possibly the very western border. Cushing[3] has given evidence to show that the northeastern Adirondack area was distinctly elevated even earlier in the late Ordovicic than the southern area. It is more than probable that this period of elevation in northern New York culminated with the great Taconic revolution.

To summarize for Ordovicic Posttrenton time we find that a considerable portion of the western side of the Adirondacks was submerged, while the whole middle and eastern portion was dry land except possibly locally along the southeastern border during the deposition of the Indian Ladder beds. After the deposition of the Frankfort shales there was an important uplift (inaugurating the Taconic revolution) which brought the whole southern Adirondack area, except probably the very western border, well above sea level, and we have no good reason to think that any considerable portion of the Adirondack region was ever again submerged.

Some of the more important conclusions, regarding the early Paleozoic physiography of the southern Adirondacks, reached in this paper are the following:

1 The early Paleozoic sea encroached upon a more or less well-developed peneplain in the Adirondack region, this peneplain being moderately rugged in the northeastern and eastern portions; less so in the southern portion; and very smooth in the southwestern portion, such a difference in character of the peneplain no doubt being due to the fact that the southwestern portion longest remained above sea level.

2 When the early Paleozoic sea encroached upon the region it did not set up embayments or estuaries in the Precambric rock area, except possibly to some extent on the eastern side, as shown by the peneplain character of the Precambric rock surface; the typical marine character of the deposits in the Paleozoic rock outliers; and the downfaulted structure of the outliers.

3 The region was never completely submerged during the Paleozoic era though, at the time of maximum submergence during the Trenton, only a comparatively small land mass remained.

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[3] Page 285.

4 The land areas varied considerably in extent from time to time, but the principal area of unsubmerged Precambric rock ran in a northeast-southwest direction through the southern Adirondack region and most likely continued through the northern region.

5 This prominent northeast-southwest structural belt or axis of elevation, occupying practically the same position as the present main axis of elevation of the mountains, has played an important part in the geological history of northern New York.

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THE GARNET DEPOSITS OF WARREN COUNTY, NEW YORK

BY WILLIAM J. MILLER

INTRODUCTION

The principal garnet mines of the United States are located in Warren and Essex counties of the eastern Adirondacks, those of Warren county — especially the Hooper and Rogers mines below described — being the greatest producers. All the Warren county mines are in its northwestern portion and within six or eight miles of North Creek village which is at the terminus of the Adirondack branch of the Delaware and Hudson Railroad.

GENERAL GEOLOGIC FEATURES

The garnet mines of Warren county lie wholly within the precambrian rock area of the Adirondacks. The oldest rocks in the garnet region are the highly metamorphosed sediments of the Grenville series. Detailed mapping by the writer has shown extensive areas of Grenville which are unusually rich in limestone and closely associated hornblende gneiss.

Next in age come plutonic igneous rocks such as syenite, granite, and granite porphyry which are clearly intrusions into the Grenville and all of which are differentiation products from the same great cooling magma. Of these rocks the syenite is, perhaps, the most abundant. It is a medium to fairly coarse grained, generally quartzose and hornblendic rock with sometimes a more basic variety carrying a green pyroxene. The granite is highly quartzose and always contains hornblende or biotite or both. The granite porphyry is biotitic to sometimes hornblendic with large, pink, feldspar crystals imbedded in a fine to medium grained matrix. All these rocks are distinctly gneissoid.

As a result of the great intrusion, the Grenville in some cases appears to have been pushed upward and to have been largely removed by erosion since; in other cases the Grenville was more or less engulfed by, or involved with, the molten flood as shown by the numerous inclusions and the areas of mixed gneisses; while in still other cases the Grenville rocks were left practically intact as shown by the large areas of pure Grenville.

Minor intrusives, cutting all the above masses, occur as bosses or dikes of gabbro, pegmatite, or diabase.

An important structural feature is the presence of numerous normal faults which have greatly dissected the region.

DESCRIPTION OF THE GARNET DEPOSITS

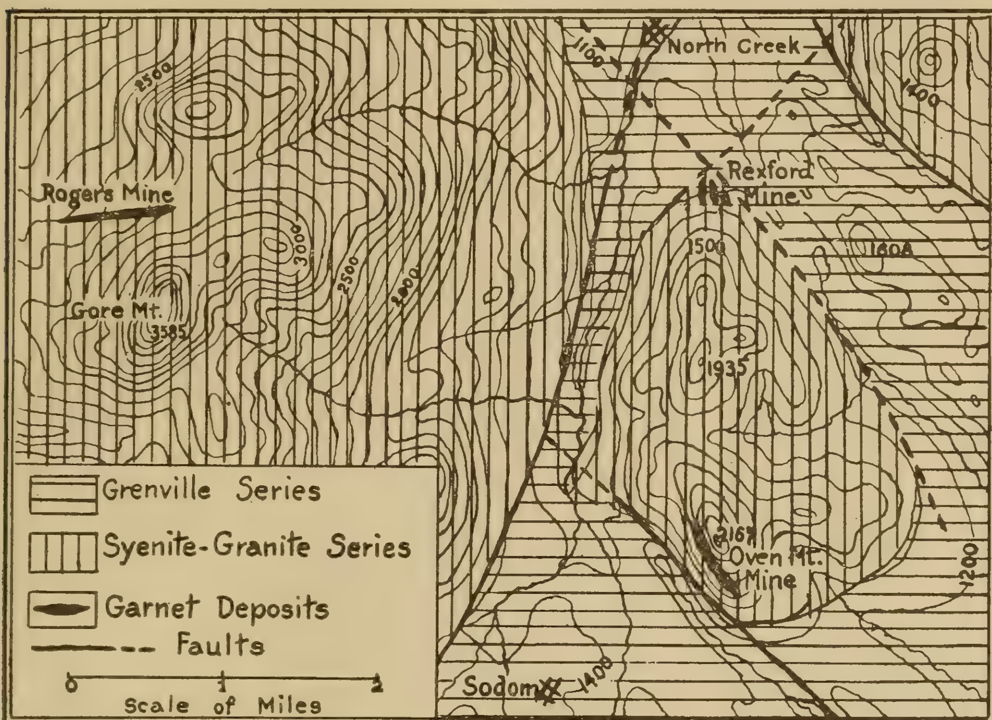
There are at least seven localities in Warren county where garnet mining has been carried on as follows: (1) Rogers (Barton) mine[1] near the top of Gore mountain and three and one-half miles west-southwest of North Creek; (2) near the top of Oven mountain and four miles south of North Creek; (3) the Rexford mine, one and one-third miles a little east of south of North Creek; (4) the Parker mine just southwest of Daggett pond and four and one-half miles northwest of Warrensburg; (5) the Sanders Brothers mine near the mouth of Mill Creek and two miles east of Wevertown; (6) two and three-fourths miles north of North Creek; and (7) the Hooper mine just east of the northern portion of Thirteenth lake. Of these, only the Rogers, Sanders Brothers, and Hooper mines are now in operation. The Rogers and Hooper mines lie within the Thirteenth Lake quadrangle and the others within the North Creek quadrangle. All the above mines have been visited by the writer.

1 In the Rogers mine the mode of occurrence and the size of the garnets are of unusual interest. The matrix or rock carrying the garnets is a gray, medium grained gneiss which, in thin section, shows: 20 per cent orthoclase; 20 per cent labradorite; 40 per cent hornblende; 15 per cent hypersthene; 3 per cent biotite; together with a little magnetite and zoisite. Imbedded in this gray matrix are numerous, well-scattered, translucent, reddish-brown garnets, those with diameters up to five or six inches being very common, while the largest ones taken out are said to have been about the size of a bushel basket. These garnets, which are of the almandite variety, are always pretty badly crushed or coarsely granulated and they never show crystal outlines.

A remarkable feature is the never failing occurrence of a rim or envelop of pure, black, medium grained hornblende crystals which completely inclose each garnet. Occasionally a half inch

[1] This is called Moore's mine on the topographic map.

irregular mass of acid plagioclase or a crystal of biotite may lie between the garnet and the hornblende rim. As a rule the hornblende rims increase in width with the size of the garnets, some rims being as much as two or three inches wide. These reddish-brown garnets, completely surrounded by the black hornblende rims which are, in turn, imbedded in the gray gneiss matrix, present a striking appearance in the walls of the great mine pits.



Geologic and topographic sketch map of portions of the North Creek and Thirteenth Lake (U. S. G. S.) sheets, showing the mode of occurrence of those garnet deposits which are lenslike inclusions in the syenite or granite.

This garnet-bearing rock clearly occurs as a long, narrow, lenslike inclusion of Grenville gneiss in the great mass of Gore mountain syenite. The inclusion is fully three-fourths of a mile long, with nearly east-west strike. Several large openings have been made in it and, in the very large more easterly pit, the width of the inclusion is more than one hundred feet. The garnet rock is removed by blasting and reduced by sledge hammers after which the garnets are picked out by hand.

2 In the Oven mountain mine the mode of occurrence is precisely like that in the Rogers mine. In thin section the matrix

shows: 20 per cent orthoclase; 25 per cent oligoclase to labradorite; 50 per cent hornblende; 2 per cent biotite; 2 per cent magnetite; together with a little pyrite, zoisite, and apatite. As compared with the similar rock from the Rogers mine the lack of hypersthene is noteworthy. Imbedded in the gray matrix are numerous shattered, reddish-brown garnets (almandite) which range in size up to several inches in diameter. Black hornblende rims are invariably present around the garnets.

This garnet rock is a long, narrow, well-defined inclusion of Grenville gneiss in a granitic facies of the great syenite-granite intrusive body.

This mine has not been worked for about twenty years. After blasting out the garnet-bearing rock and reducing it by sledge hammers, the garnets were picked out by hand.

3 At the Rexford mine the type of occurrence is much like that of Oven mountain, only here there appear to be several smaller inclusions of the garnet-bearing gneiss instead of one, and the country rock is a very gneissoid quartz-syenite. Garnets up to five inches across, always with hornblende rims, were noted. There are several mine openings but none have been worked for about fifteen years.

4 The old mine on the Parker farm occurs in a mixed gneiss area with granitic syenite and Grenville interbedded parallel to the foliation strike. These bands of rock are often twenty to forty feet wide, one of them being made up of a nearly pure, granular, medium grained mass of irregular crystals of reddish-brown garnet and bright green pyroxene (coccolite?). About twenty years ago this band of garnet rock was mined, crushed and put into barrels, there being no attempt to separate the pyroxene from the garnet.

5 At the Sanders Brothers mine the mode of occurence is very similar to that of the Parker mine, the bands of Grenville being, however, somewhat less pronounced and numerous. The rock which is mined is pretty badly granulated and consists mostly of intimately associated reddish-brown garnet and green pyroxene (coccolite?) in small grains, with sometimes a little quartz and feldspar. There are some streaks or patches of nearly pure garnet. Work began in 1907 on the south side of the creek, but now all the mining is confined to the north side. The garnet-pyroxene rock is crushed, put into bags, and shipped to all parts of the world.

6 Years ago an attempt was made to mine the garnets which occur in the coarse, feldspar, biotite, garnet, Grenville gneiss two and three-fourths miles north of North Creek, but this locality is of no special interest.

7 At the Hooper mine the garnets occur as crystals (dodecahedral) often with good crystal boundaries, up to an inch or a little more in diameter. They are thickly scattered through a medium to moderately coarse grained, dark to light gray, very gneissoid, hornblendic rock which has the composition of a basic syenite or an acidic diorite. It is important to note that these garnets never show the rims of hornblende. In fact the garnets may sometimes be almost surrounded by feldspar. This type of occurrence has not been observed on a large scale at any of the other localities within the county, though a rock almost exactly like it occurs at the Rogers mine as a distinct zone (wall rock) intermediate between the typical garnet-bearing gneiss and the country rock of syenite, where the garnet rock grades perfectly into the syenite. The significance of this fact will be explained below.

The deposit is an extensive one and a very large mine pit has been opened up. After blasting out the rock, it is somewhat reduced by sledge hammers, then taken on cars to the mill where it is crushed. By the use of an ingenious method, involving the use of jigs, the garnet (almandite) is almost perfectly separated from the rest of the crushed rock which is of lower specific gravity than the garnet.

ORIGIN OF THE GARNETS

All modes of occurrence of garnets observed by the writer on the North Creek and Thirteenth Lake sheets are summarized as follows:

1 As crystals or grains in various Grenville rocks, for example, the garnet-pyroxene gneiss; the hornblende-garnet gneiss; biotite-garnet gneisses, etc.

2 As distinct crystals frequently occurring in all types of intrusive rocks — syenite, granite, granite porphyry, and gabbro — except the diabase.

3 As large more or less rounded masses with distinct hornblende rims in the long, lenslike inclusions of Grenville hornblende gneiss in syenite or granite.

4 As more or less distinct crystals (dodecahedral), without hornblende rims, in a certain special basic syenitelike or acidic dioritelike rock.

In case number 1 (for example, Parker and Sanders Brothers mines) the garnets have, in the usual manner, crystallized out of masses of sediments under conditions of thermal and dynamic metamorphism. These garnets are rarely as much as an inch across and their origin presents no problem of special interest.

In case number 2 the garnets appear mostly to have crystallized out of the original magmas, their formation possibly having been due to some assimilation of granville sediment by the syenite or granite. The facts that these garnets occur so sporadically and that actual examples of local assimilation have been observed in the region strongly favor this view. Since these garnets seldom attain a diameter of an inch and are so scattered, no attempt has ever been made to mine them. Sometimes, as in the gabbros, the garnets have often been produced secondarily, or after the cooling of the magma, because they commonly form reaction rims around other minerals.

Case number 3 (for example, Rogers, Oven mountain, and Rexford mines) is of particular interest because of the very large garnets surrounded by the reaction rims of hornblende.

Kemp and Newland[1] have briefly described a garnet deposit (formerly worked by the Messrs Hooper) just across the line in Essex county less than a mile west of the village of North River and four and one-half miles north of the Rogers mine. As judged by their description the type of occurrence appears to be similar to that in the Rogers, Oven mountain, and Rexford mines, though no mention of the hornblende rims is made. In conclusion they say:

> The origin of this peculiar bed presents an interesting theme. The country rock is probably igneous. Its mineralogy and structure favor this derivation. The garnet rock must be either an altered form of a very impure limestone, or else a very basic igneous rock that was an original sheet or dike. The former supposition appeals more strongly to us.

Later Newland[2] says of the garnet deposits in general that:

> The garnet is usually associated with a basic hornblende rock or amphibolite which forms bands and lenses in the more acid gneiss that constitutes the country rock.

In his brief description of the more recently worked garnet deposit of northern Essex county he speaks of the "amphibolite bands, which have been caught up during the intrusion of the

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[1] 17th An. Rep. N. Y. State Geol., 1897, pages 548–49.
[2] N. Y. State Mus. Bul. 102, page 71.

anorthosite, or have been folded into the latter and metamorphosed."

From these statements we see that three possible modes of origin of these garnet-bearing beds have been suggested, namely that they are: lenses of sedimentary rock actually included in the igneous rock; or sediments folded into the igneous rock and metamorphosed; or sheets or dikes of very basic igneous rock. Now the work of the writer shows that, without question, these garnets occur in lenses of Grenville sediments which were caught up or included in the great igneous masses at the time of their intrusion, the tremendous heat and pressure being especially favorable for a very complete rearrangement and crystallization of the masses (inclusions) of sediment which were pretty low in silica. These inclusions are portions of a great thickness of hornblende-garnet gneiss, frequently interbedded with limestone, of the Grenville series. This gneiss is a basic rock generally carrying several per cent of magnetite; sometimes considerable hypersthene; and little or no quartz. It is quite likely that some of the closely involved limestone was mixed with the inclusions of sediment during the process of metamorphism. It will at once be seen that such an iron-rich, silica-poor sediment was very favorable for the development of large garnets under the conditions of great heat and pressure which were brought to bear upon the lenslike inclusions in the molten syenite or granite.

The hornblende rims or envelops are quite certainly great reaction rims around the garnets, but just at what stage of the metamorphism they were produced is not at all clear to the writer. The rounded character of the garnets shows pretty clearly that the rims of hornblende are of secondary origin and that they were formed sometime after the crystallization of the garnets and possibly at the time when the pressure producing the foliation of the rocks of the region was brought to bear.

In case number 4 (Hooper mine) a clew to the origin of the garnets is furnished by a study of the wall rock in the Rogers mine on Gore mountain. In this latter case the typical garnet-bearing rock (No. 1 of the accompanying table) of the mine passes by perfect gradation, through an eight or ten foot zone, into a basic syenite or acidic diorite (No. 2 of the table) which contains distinct dodecahedral garnet crystals up to over an inch across but always without hornblende rims. This rock, in turn, grades into a hornblende (quartzless) syenite (No. 3 of the table) which merges into the typical country rock of quartz, hornblende syenite, these

two latter rocks being at times somewhat garnetiferous. The writer is fully convinced that this transition zone (wall rock) has been formed by assimilation or actual melting or fusing together of the syenite and the border of the great inclusion at the time of the intrusion.

TABLE SHOWING THE MINERALOGICAL COMPOSITION OF THE MATRIX OF THE GARNET-BEARING ROCK IN THE ROGERS AND HOOPER MINES [1]

		Orthoclase	Plagioclase	Hornblende	Biotite	Hypersthene	Magnetite	Zoisite	Apatite	Pyrite	Zircon
Rogers mine	1	20	Lab. 20	40	3	15	1	1			
	2	30	Ol.-an. 30	36			1	2	little	1	
	3	50	And. 25	24				1	little		
Hooper mine	4	42	Ol.-and. 20	30	5	2		½			½
	5	30	Ol.-and. 35	33	½	½	1				little
	6	40	Ol.-and. 20	35		4	1				

[1] A close approximation to percentage by volume only is intended.

As shown in the field, in hand specimens, and in thin-sections the garnet rock (Nos. 4, 5, and 6 of the table) at the Hooper mine is almost exactly like the wall or transition rock of the Rogers mine, and it also appears to grade into the country rock. In each case the garnets never show reaction rims of hornblende and the garnets often show good crystal outlines. In the Hooper mine this transition or intermediate rock makes up practically the whole mass which is mined and is thus much more extensive than at the Rogers mine. All evidence points to the origin of the Hooper mine rock as due to rather thorough melting of an admixture of syenite and Grenville sediment where the Grenville inclusion was perhaps deeper down in the magma and hence subjected to much greater heat, or possibly a number of smaller hornblende gneiss inclusions, perhaps with some limestone, were assimilated by the molten syenite.

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THE USE OF THE STEREOGRAM IN PALEOBIOLOGY

BY GEORGE H. HUDSON

The earliest form of the stereoscope was devised by Sir Charles Wheatstone to illustrate the phemomena of binocular vision. This instrument was made known in 1838 and very simple line stereograms were drawn to accompany it. By a curious coincidence Daguerre succeeded in perfecting his photographic process during the same year and thus opened the way to the production of stereograms which would possess something more than a purely theoretical interest. Thus the stereoscope and the rather bulky and clumsy form of mounted stereogram developed together and the former became specialized or adapted for use with the latter only.

In these days of cheap and excellent methods of reproducing photographs there is no valid reason why stereograms should not be printed and bound together with descriptive text in book form. This would only be a step in the direction of "scientific management." It would save time now lost in keeping the loose stereograms in order, in finding the one desired and in replacing it after use. It would insure against loss and damage. It would open avenues for use now unfortunately closed. Stereograms could be made to illustrate books of travel, textbooks, scientific papers and popular magazine articles dealing with the world and its workers in all spheres of human activity from the mine to the stage. To open this new field we need only a stereoscope that shall rest on the page while being focused or adjusted.

This article has been prepared to demonstrate the desirability of using stereograms to illustrate scientific papers. The field chosen lies both in biology and paleontology. The illustrations are confined to a few species of sea stars but both recent and fossil forms are represented.

As a temporary makeshift to enable us to see our plates as solids we will use the ordinary Holmes stereoscope in one of the following ways.

Let the observer seat himself before a table arranged to let a good light reach the page from the left side. In front and about ten inches back from the edge of the table place two or three moderately heavy books. Slide the transverse card carrier off the end of the rail of the stereoscope and place this end against the lower edge of the bottom volume. By now placing the forehead against the hood and using a gentle pressure it is easy to hold the instrument at an angle of about forty-five degrees and at the same time look through the lenses. Both hands are free to bring any stereogram into proper position and focus. The line separating the two views must be kept near the center of the rail and the lower edge of the stereogram kept parallel with the horizontal edges of the lenses.

This end may also be attained by placing the stereogram with its lower edge close to the edge of the table and holding it as nearly flat as possible with proper weights. Then hold the rail of the stereoscope vertically against the edge of the table and move up or down to focus.

For a quickly made but more permanent device, procure two pieces of board, one 10 inches x 12 inches x $\frac{7}{8}$ inch and the other 2 inches x 1 inch x $\frac{7}{8}$ inch. Fasten the smaller piece under the middle of one of the 10 inch edges, keeping the two $\frac{7}{8}$ inch faces flush with each other. A simple clamp will hold the rail of the stereoscope against this $1\frac{3}{4}$ inch face. Two or more elastic bands around the board will hold the volume to the stage and both hands may be left free for other work.

Still more desirable would be a large inclined stage with spring clips and a stereoscope body that could be focused by means of a rack and pinion as in a binocular microscope. A cheap and convenient form could be modified after Brewsters "box" stereoscope in which the loaded base of the instrument should rest directly on the printed page.

If the reader will seek through one or another of the means here suggested to view these stereograms serially and in

relief he will realize that the advantages secured are of sufficient importance to warrant the use of this means of illustrating scientific papers.

In order to avoid unnecessary turning of leaves and consequent readjustments, the matter especially referring to each of the following plates has been printed on the page facing it.

Plate 1 Palaeaster parviusculus Billings x 9.5 dia. Canadian Nat. & Geologist, v. 5, no. 1, page 69 (Feb. 1860). From lower Arisaig series. Arisaig, Nova Scotia. The unique holotype in McGill College collection no. 1586

View first without stereoscope and note the white patches over interradius (*a*) and along the margins of arms (*B*) and (*C*). On viewing stereoscopically these are seen to be thin shells of calcite belonging to the surface of the oral ossicles and not yet completely removed from the mold. A perfect cast might show this loss from plate surfaces but the clear delimitation, here so easily made manifest by the difference in reflective power, would be absent.

These figures viewed without the stereoscope may present the appearance of either a mold or a cast, thus adding to the difficulty in interpretation. In both items the advantages of the stereogram are very pronounced.

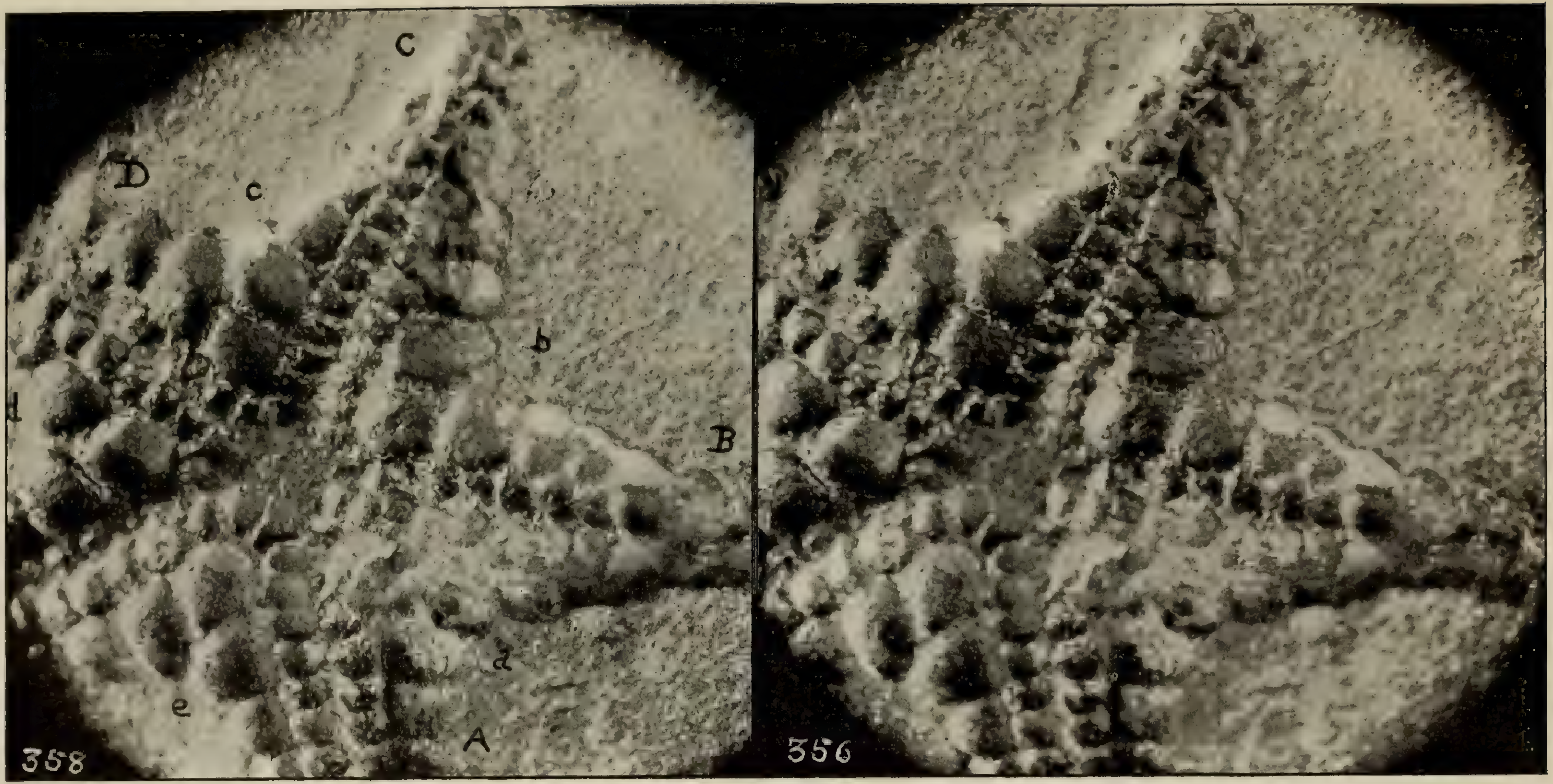
C
D
c
b
B
d
a
e
A
358
356

Plate 2 Palaeaster parviusculus Billings x 9.5 dia.

From a wax squeeze

A squeeze is subject to certain serious defects. The mold may retain some imprisoned air or other fluid. The fluid that escapes from the mold under pressure may make deep folds or distorted channels in the plastic medium used. This medium must also flow out from under the place of greatest pressure and when any two portions of a stream meet in the lee of a projection they can not wholly obliterate the traces of the fold so produced.

In this squeeze one of the marginals, in interradius (*c*) is made to appear as three very distinct but irregular ossicles. Of minor prominence are the folds crossing the lower marginals and adambulacrals of arm (*A*). Still more minute are the numerous lines of flow leaving interradius (*e*) and radius (*E*).

In the Victoria Memorial Museum at Ottawa is a plaster cast of this species showing several adambulacra with central depressions suggestive of those shown in our plate 5, but caused by bubbles of air imprisoned in the deepest recesses of the mold.

The artifacts here enumerated are manifestly absent from the stereogram.

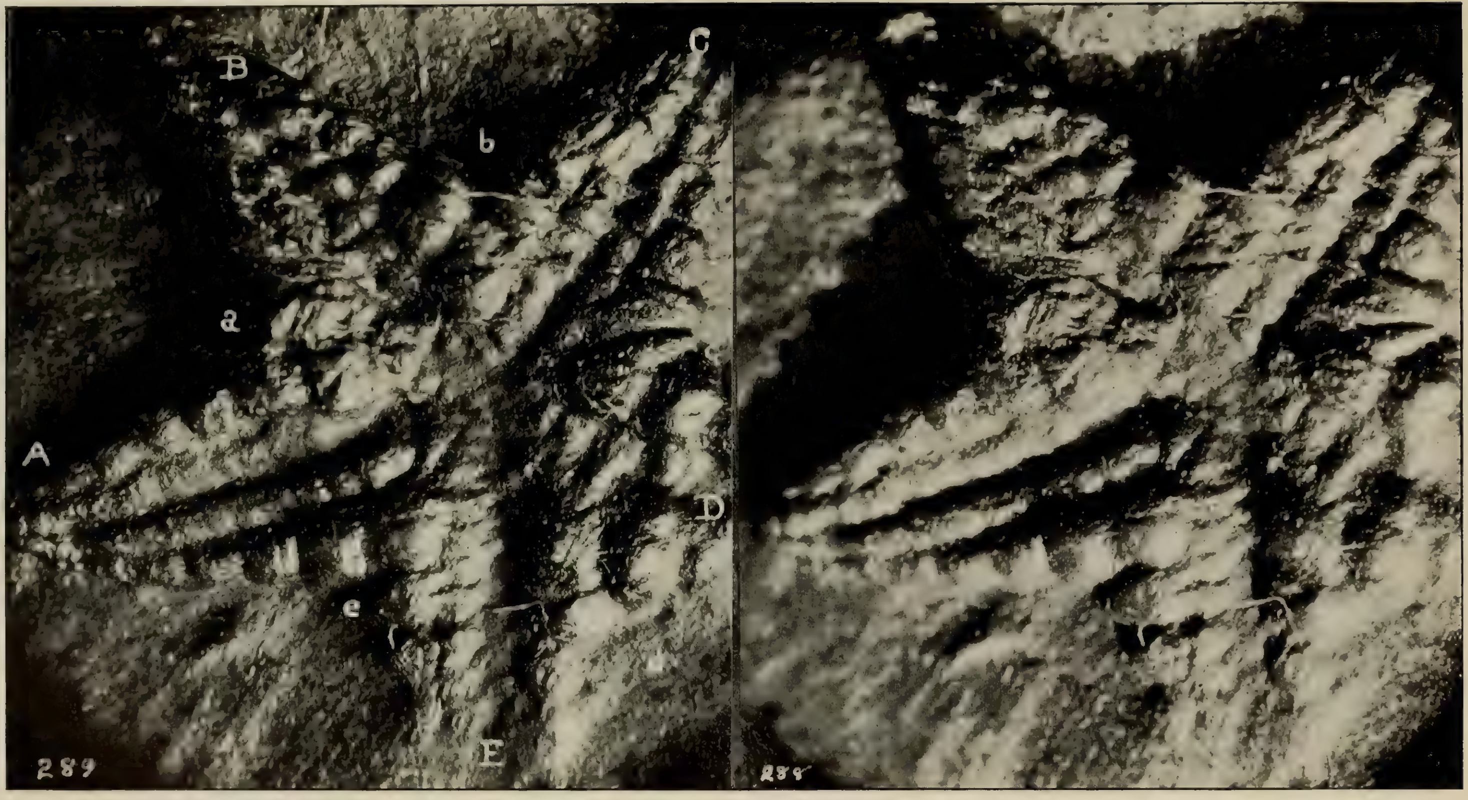
A
B
C
D
E
a
b
e
289
289

Plate 3 P a l a e a s t e r p a r v i u s c u l u s Billings x 9.5 dia. From two negatives showing more of the detail of arm *A*. The left view has here been mounted as the right and vice versa, giving closely the appearance of a cast.

In interradius (*e*) note the flat oral surfaces of the pair of adambulacrals forming the " jaw " and their decided inclination toward the interior.

In arm (*A*), lower row of adambulacrals, note the elevated positions of the 3d, 7th, 9th and 11th; in arm (*B*) left row the 9th and in right row the 6th, 7th and 8th. Note also the cases of marked depression. This is evidence for a muscular system that could raise or lower individual adambulacra.

The oral faces of both marginals and adambulacrals seem to be minutely tuberculated and the marginals in places appear to show traces of recumbent small spines. The condition of the surface of the mold must be clearly understood, however, before definite conclusions are drawn.

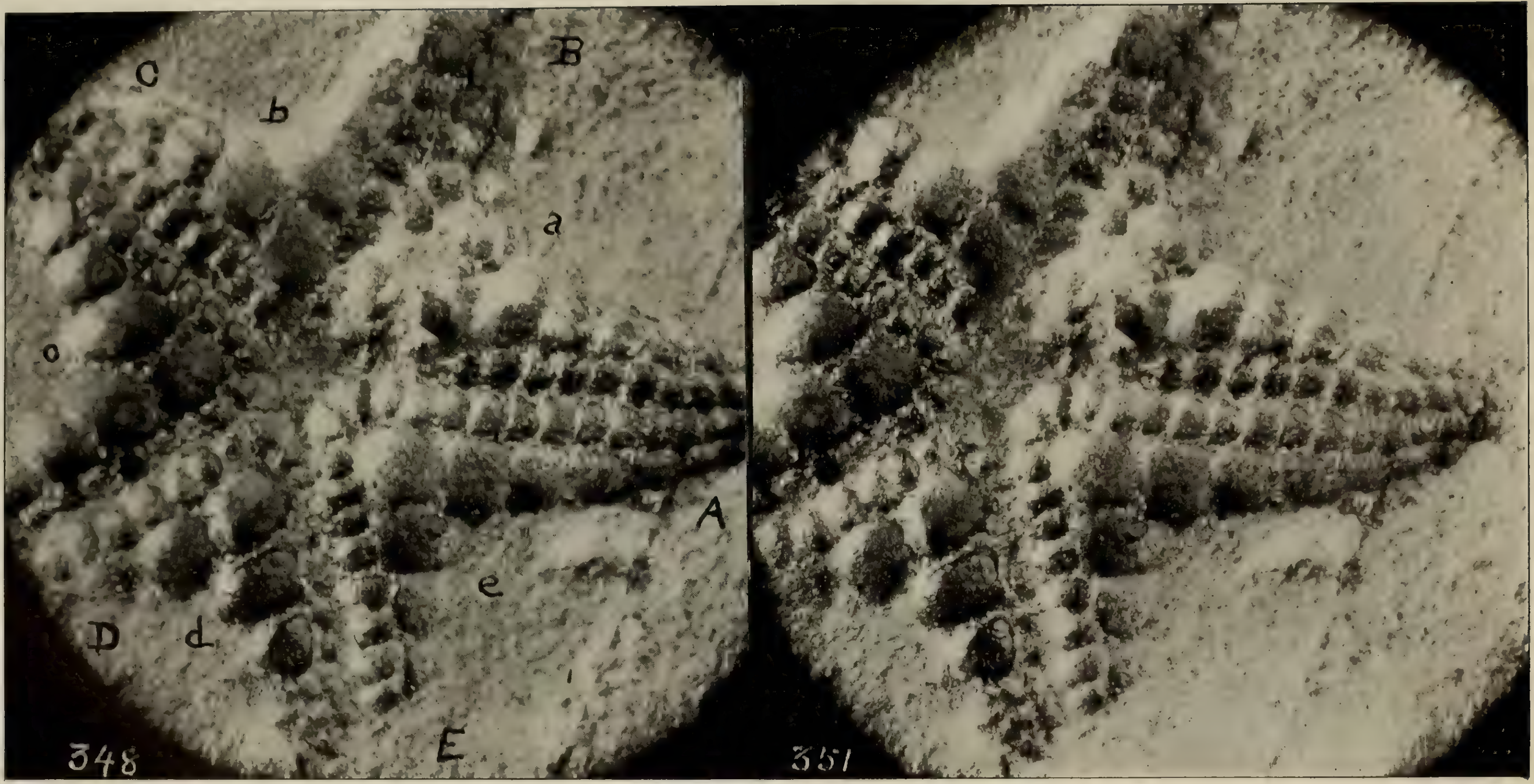
C
b
B
a
o
A
e
D
d
E
348
351

Plate 4 Palaeaster parviusculus Billings x 9.5 dia. Photographed under gum damar.

In order to secure a still better representation of the plate surfaces the thin shells of calcite were rendered transparent by mounting with gum damar. The remains of a blackened integument covering the oral surface and slightly descending between the ossicles, as folds, is here made manifest. Plate boundaries are now more clearly defined.

Note that where the adambulacra are in opposite positions, as in the outer portion of arm (*B*), they leave a single medial row of small diamond-shaped openings. Where they are placed alternately they meet those of the opposite row still more closely and the diamond-shaped openings are closed. If this species possessed true ambulacra they were completely hidden in this closed condition of the arm. It is evident that individual adambulacra were permitted a small radial motion, orad or aborad.

With the mold itself for study, Mr Billings made out " twelve or fourteen " adambulacra " in each row." Plate 3, arm *A*, shows sixteen. He wrote, " and they seem to be continued round the edge of the oral plates." We need express no doubt about this. We are also enabled by these new methods to note many other interesting details that Mr Billings could not see with the specimen itself in hand. For his purpose these stereograms would have served better than the type.

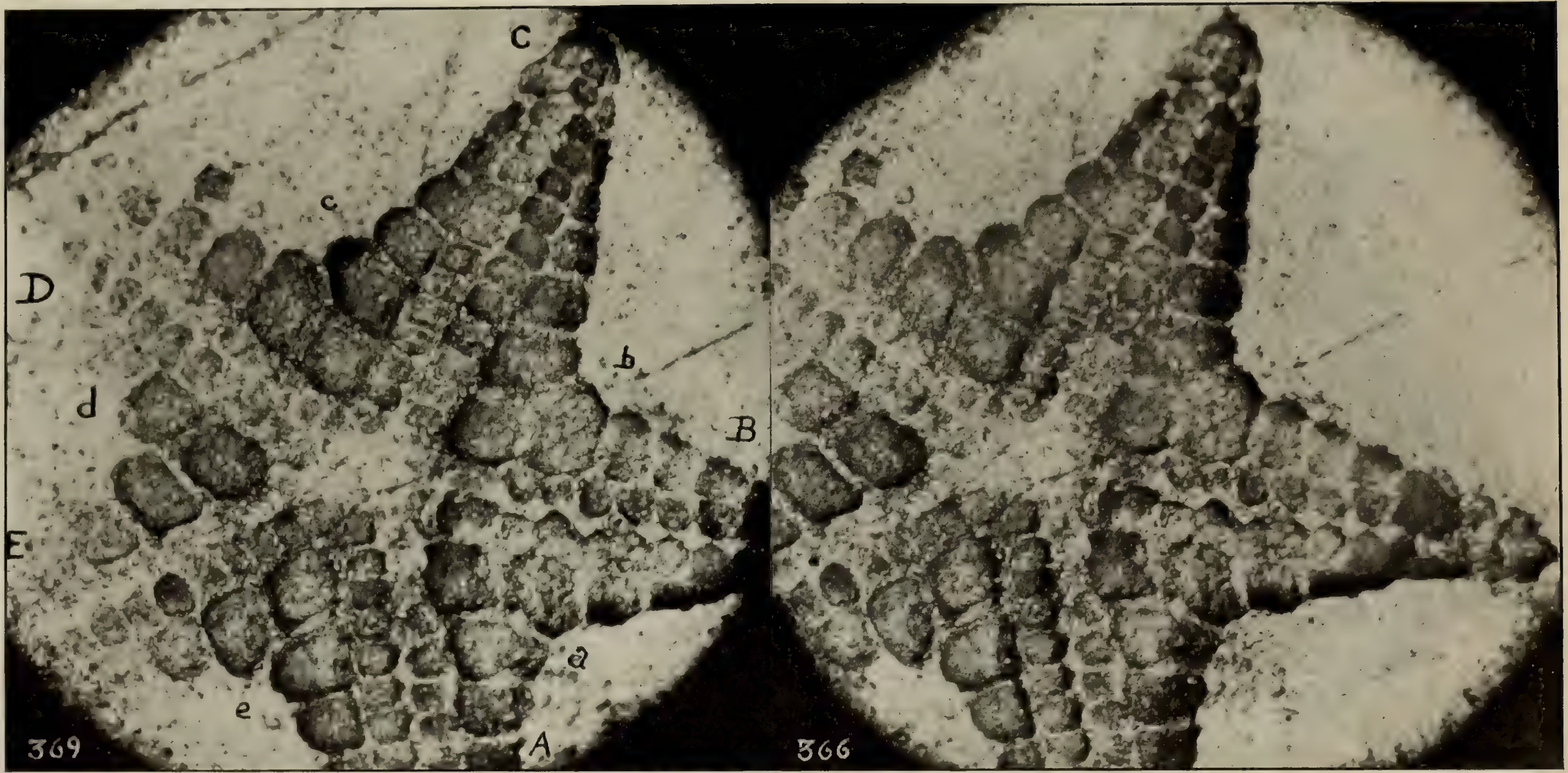
C
c
D
b
d
B
E
a
e
369
A
366

Plate 5 Protopalaeaster narrawayi Hudson. x 10 dia. Photographed under gum damar. Ottawa Naturalist, volume 26, pages 21–26, 45–52. May, June, July, 1912. Lower part of Black River limestone, Ottawa, Can. Holotype in private collection of Mr J. E. Narraway, Ottawa.

Note the " covering plates " of arm IV. These are continued around and partly over the single interradial marginals as shown in interradii 3 and 4. Under each interradial pair, a pair of peculiar plates (" secondary jaws ") are seen in position in interradii 2 and 5 and displaced in interradius 1. Under these again are single, apparently crescent-shaped ossicles which appear to have been attached either to a secondary jaw or to an interradial pair of adambulacra (see interradius 1). In interradius 1 the crescent-shaped ossicle appears to be connected with a portion of an aboral covering consisting of some fifteen or more minute ossicles having a diameter of about 0.1 mm each. Note the flat or bevelled surfaces of the pairs of adambulacra forming the jaws in interradii 1 and 2 and the slope toward the mouth precisely as in P. parviusculus. Three ossicles with others now lost were thrust over this specimen from interradius (4) as is shown by the displacement of the two 3d covering pieces in arm IV, the interradial covering pieces in interradius 4 and the displaced pair of " secondary jaws " and oral in interradius 1.

The stereogram not only gives us an impression of depth but it may enable us to make very accurate measurements of the third dimension. In plate 5 a mote of dust settled on the cover glass over the fifth adambulacral of the lower row in arm V. The light reflected by this mote makes it appear as a white speck. As seen in the left view this speck lies between the fifth and sixth adambulacra; as seen in the right view it lies near the inner point of the fifth adambulacrum. The parallax is easily measured and with the angle of view known, here about 18°, the distance from the visible surface of the cover glass to the adambulacrum is easily computed. With a few depths known, the others are easily estimated. The greatest depth shown in this plate is 1.5 mm.

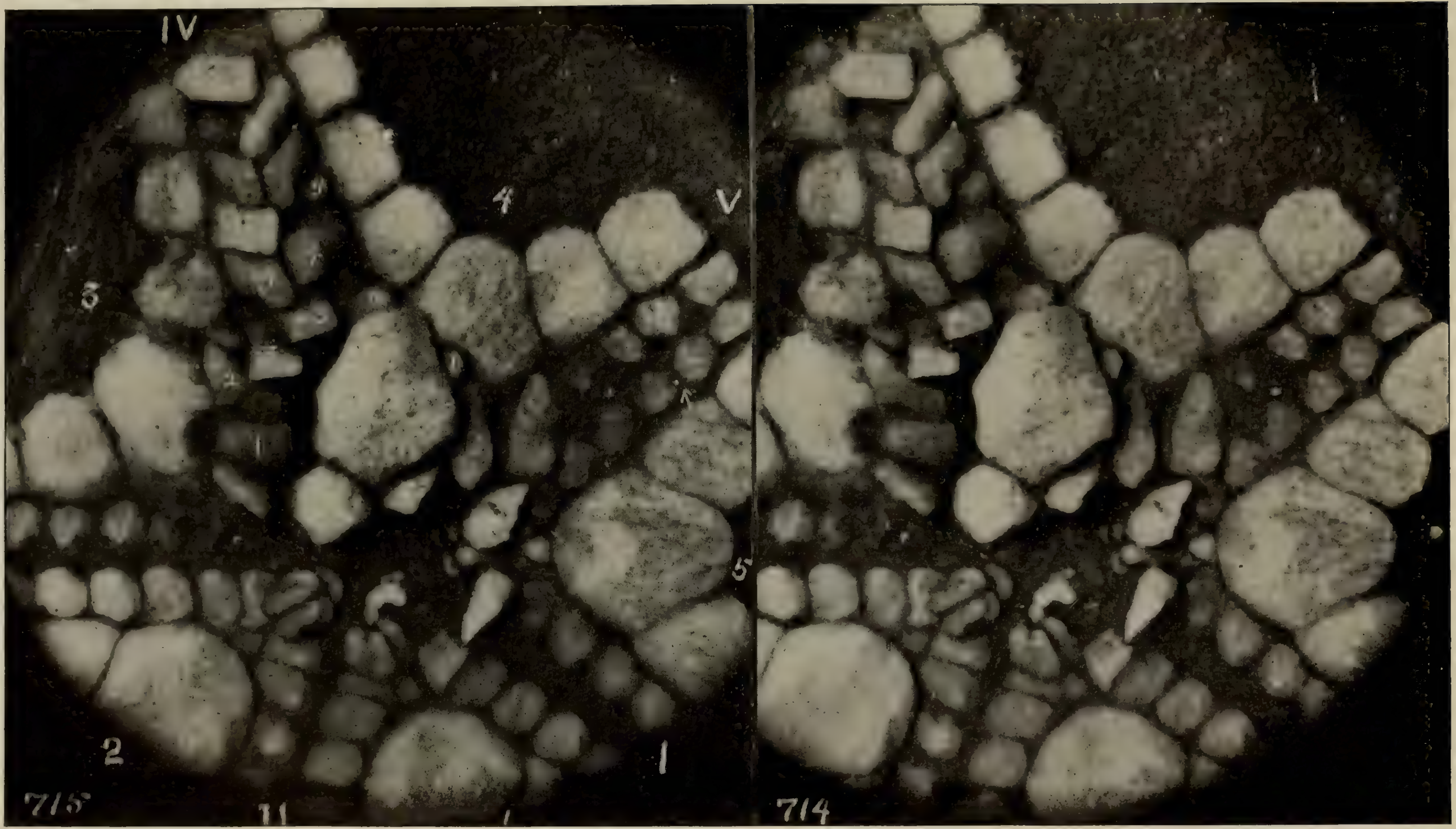
IV
V
4
3
5
2
1
715
11
714

Plate 6 Benthopecten simplex Perrier, oral aspect x 10 dia. West Indies, 1323 fathoms. Specimen from Museum of Comparative Zoology, Cambridge.

This specimen was loaned by Dr Hubert Lyman Clark, who called attention to its apparent close generic similarity to P. narrawayi. This plate and the two which follow it are here presented to emphasize, first, the need and value of more careful comparison of ancient and recent forms of life; second, to show that published stereograms may be made to foster such study; and third, to illustrate certain advantages of the gum damar mounting. As the fossil forms ought to have a message for students of recent material and the recent forms a message also for paleobiologists, no special argument is here needed to support the first proposition. For the second, compactness; ease of comparison; freedom from effort to assemble rare and scattered types; saving of time; saving of rare specimens themselves from loss or damage; possibility of reconstruction by models of forms after loss by fire, or accident; and the truthfulness of the stereogram itself, should be sufficient recommendation. To appreciate the changes produced by the damar mounting, this plate should be carefully compared with the next.

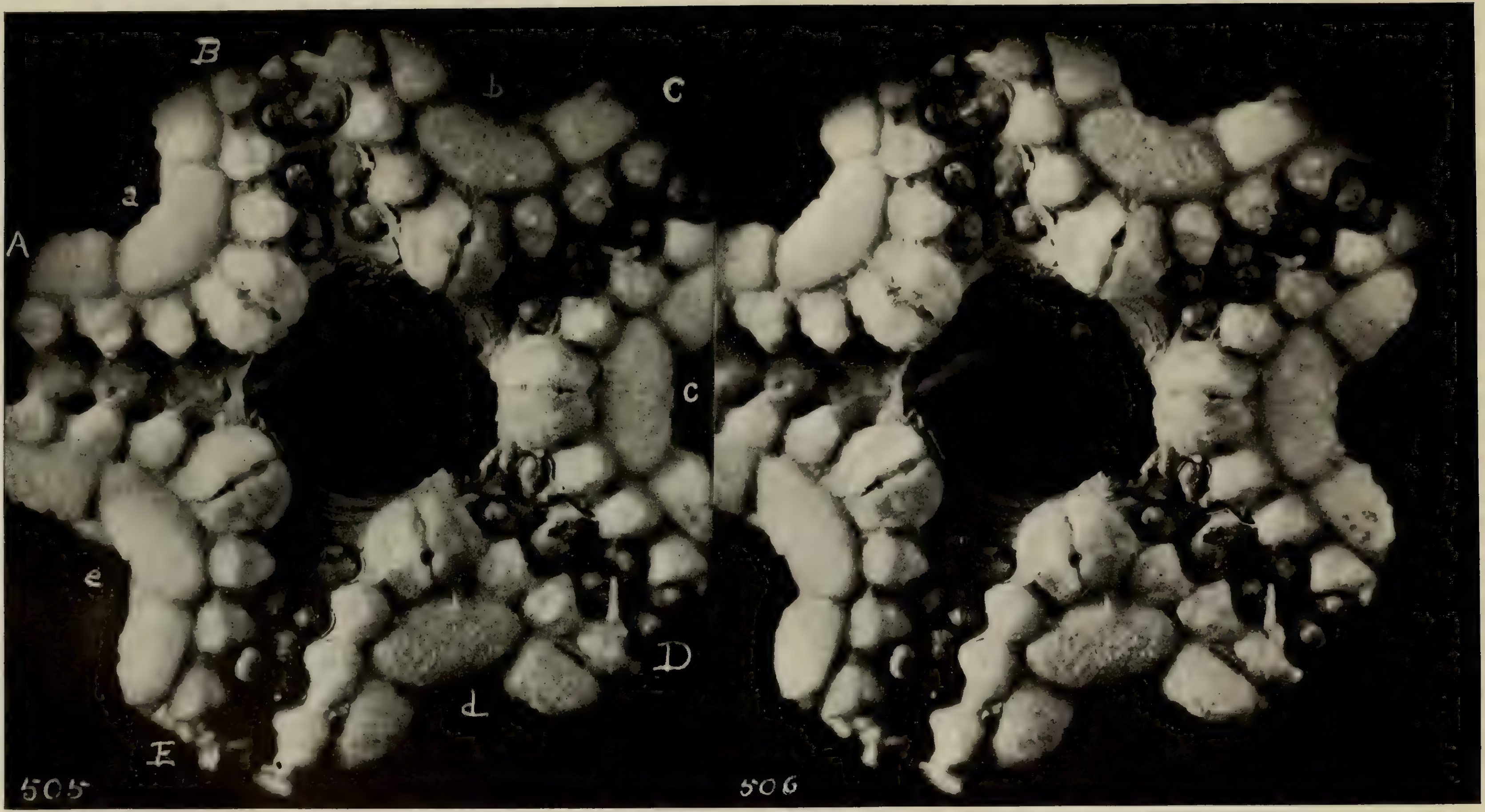
A
B
a
b
C
c
D
d
E
e
505
506

Plate 7 Benthopecten simplex Perrier, oral aspect under gum x 10 dia.

We have here lost the outer light reflecting surface of minute granules, and have rendered transparent a thin outer layer of the ossicles and of some of the tissues associated with them. Portions of the preserved softer parts, here seats of muscular activity, are rendered in black. Three kinds of tissue seem to be clearly differentiated, that of the ossicles, a ligament like tissue connecting an adambulacrum with its neighbors in the same row, and a scattered muscular system of fine separate fibers.

At the end of arm *E* an adambulacral has been removed and we see a pit in the articulating surface of an ambulacral, filled with fine black fibers. That the adambulacrals possessed corresponding pits is revealed by the darkening of the plate centers which shows them to have been thinner in this portion. The mouth plates are formed by the interradial pairs of adambulacra but to the orad edge of each there appears to be fused an additional piece. These fused pieces are suggestive of the peristomial covering plates of Protopalaeaster narrawayi. An orad may be seen under the first pair (parted mouth plates) of adambulacra in interradius (*b*). A portion of a dark but almost transparent radial canal is seen in arm *E*.

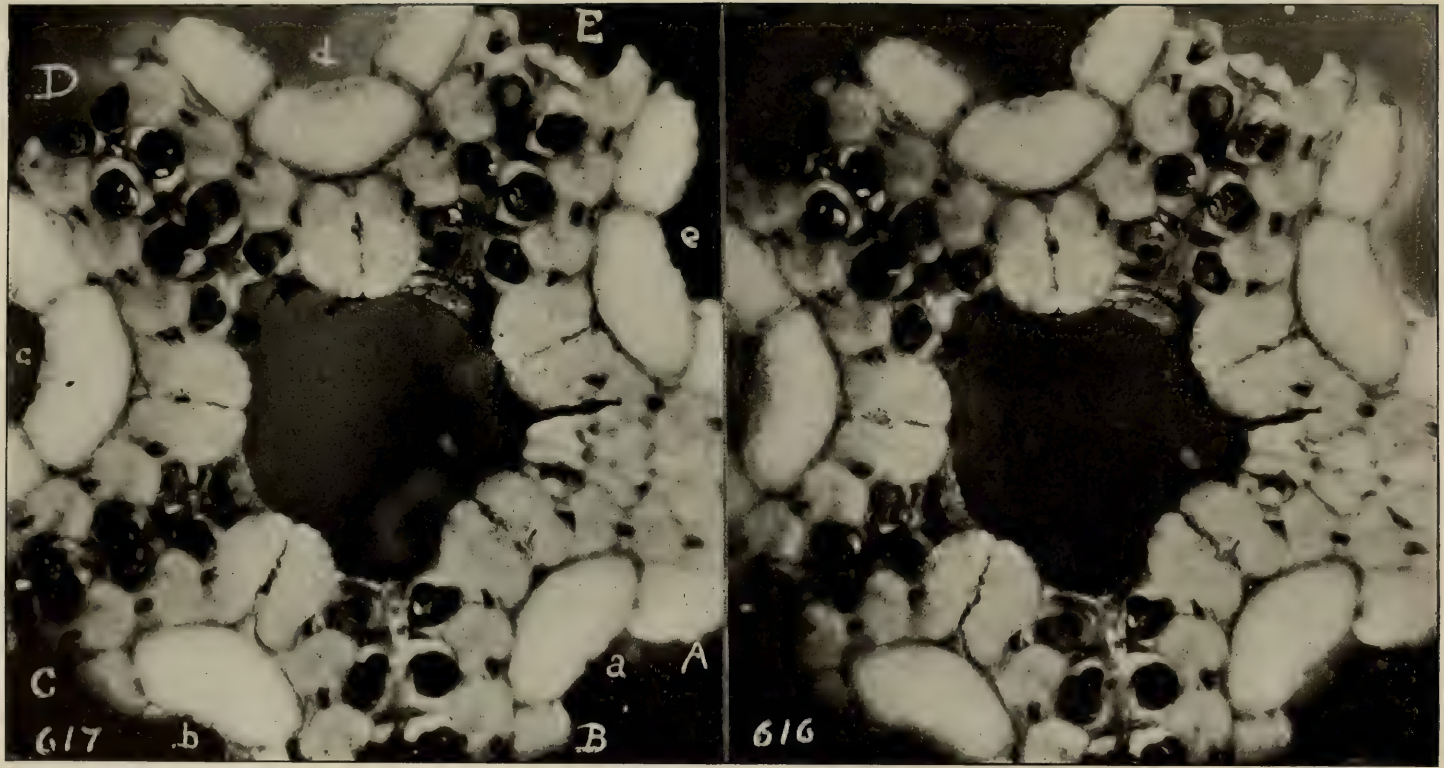
D
d
E
e
c
C
a
A
617
b
B
616

Plate 8 Benthopecten simplex Perrier, oral plates from aboral aspect, under gum x 10 dia.

In interradius (*d*) are seen a pair of ambulacral plates, which are inclined orad as if to support the fused distal pieces of the jaw plates, but which also have one shoulder recurved or arched to pass beyond the edge of the oral and support a proximal piece (first adambulacral) of the jaw plate. These first ambulacral plates do not meet their neighbors across the furrow but each is supported by a shoulder on the oral side of a second ambulacral. Each ambulacral, however, supports not only its own ambulacral but it also sends a small shoulder orad to in part support the next adambulacral. The strong ambulacra and weaker adambulacra both rest against the flattened inner wall of the marginals. Were the arms in a more contracted or closed position the oral aspect of this species would present a medial row of diamond-shaped openings for each arm and if Palaeaster parviusculus possessed ambulacra, its oral skeleton must have been remarkably like that of Benthopecten.

The added transparency secured by the gum process is very manifest in working with fossils. Aside from the effects secured in plate 4, we should also note the transparant surfaces of the ossicles in plate 5, interradii 4 and 5. Buried black grains may be detected to a depth of at least 0.1 mm.

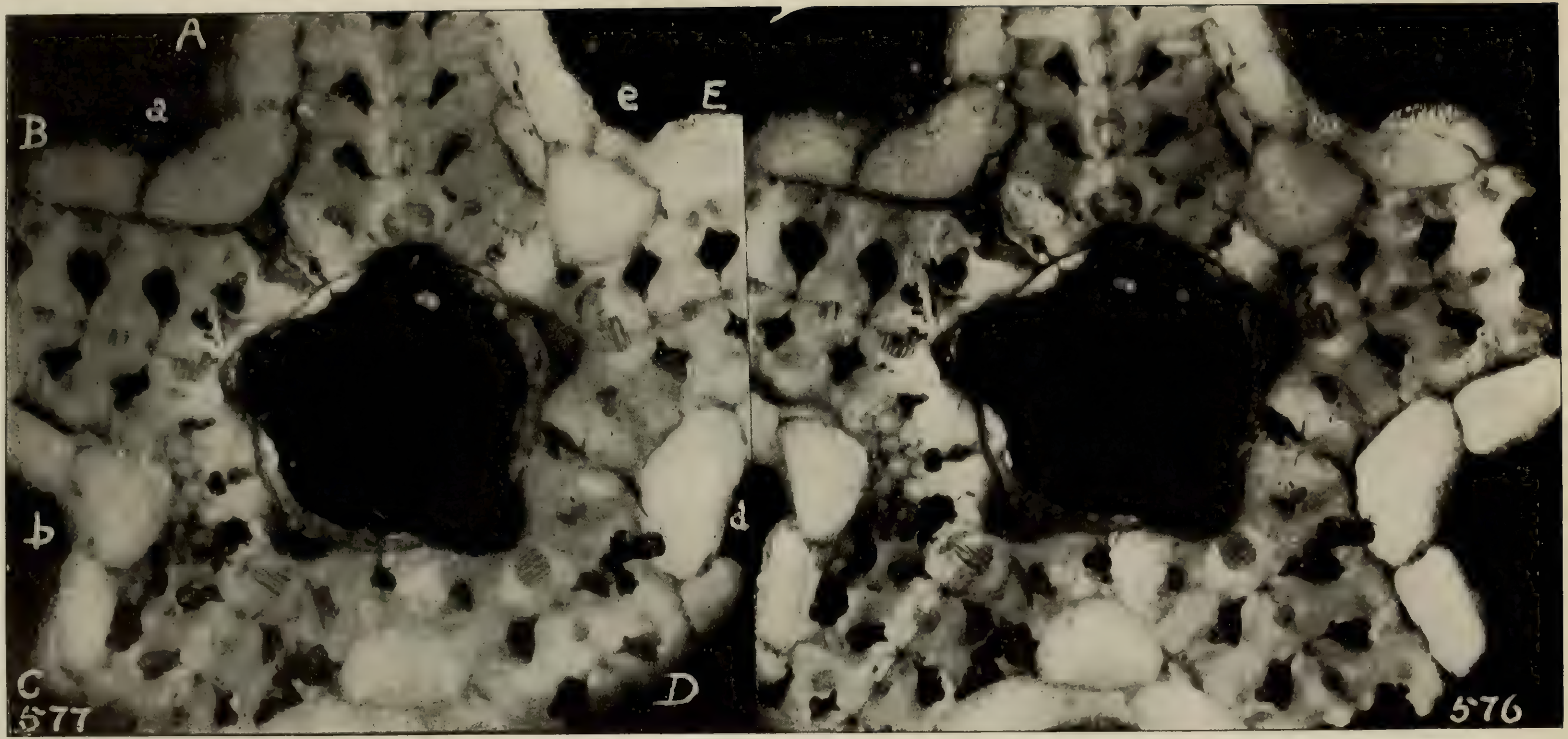
A
B
a
e
E
b
d
C
577
D
576

Plate 9 Palaeaster niagarensis Hall.

Detail of oral surface of disk under gum x 9.5. Paleontology of New York. Volume 2, pages 247–48, plate 51, figures 21–23. Cornell University collection, no. 7331. Niagaran. In the shale at Lockport, N. Y.

Pointing orad from the big marginal in interradius 4 is a dark, flattened spine that evidently was one of a pair which met each other with a straight inner edge. The "mouth plate" so formed was longer and more acute at tip than in Benthopecten simplex. These pieces can hardly have been highly modified adambulacra but they are remarkably like the pair of "covering pieces" which were seen in Protopalaeaster narrawayi (plate 5, interradius 3). The attachment to the marginal seems to have been made by means of a granular flexible base allowing much freedom of movement. A second piece with its attachment carried away is present in interradius 2. The surface ornamentation of these pieces enables us to recognize fragments of others.

In radius III we may note two spines with widened bases that appear to have been supported by the sides of the interradial marginals and are still in position to cover the furrow.

The area exposed has evidently lost much valuable detail through the first crude efforts to "clean" this region. A careful development may still yield evidence of value, but the stereogram should be used to preserve all features it may be found necessary to remove.

For transparent effects from the gum mounting study the big marginals in interradii 2, 3 and 4.

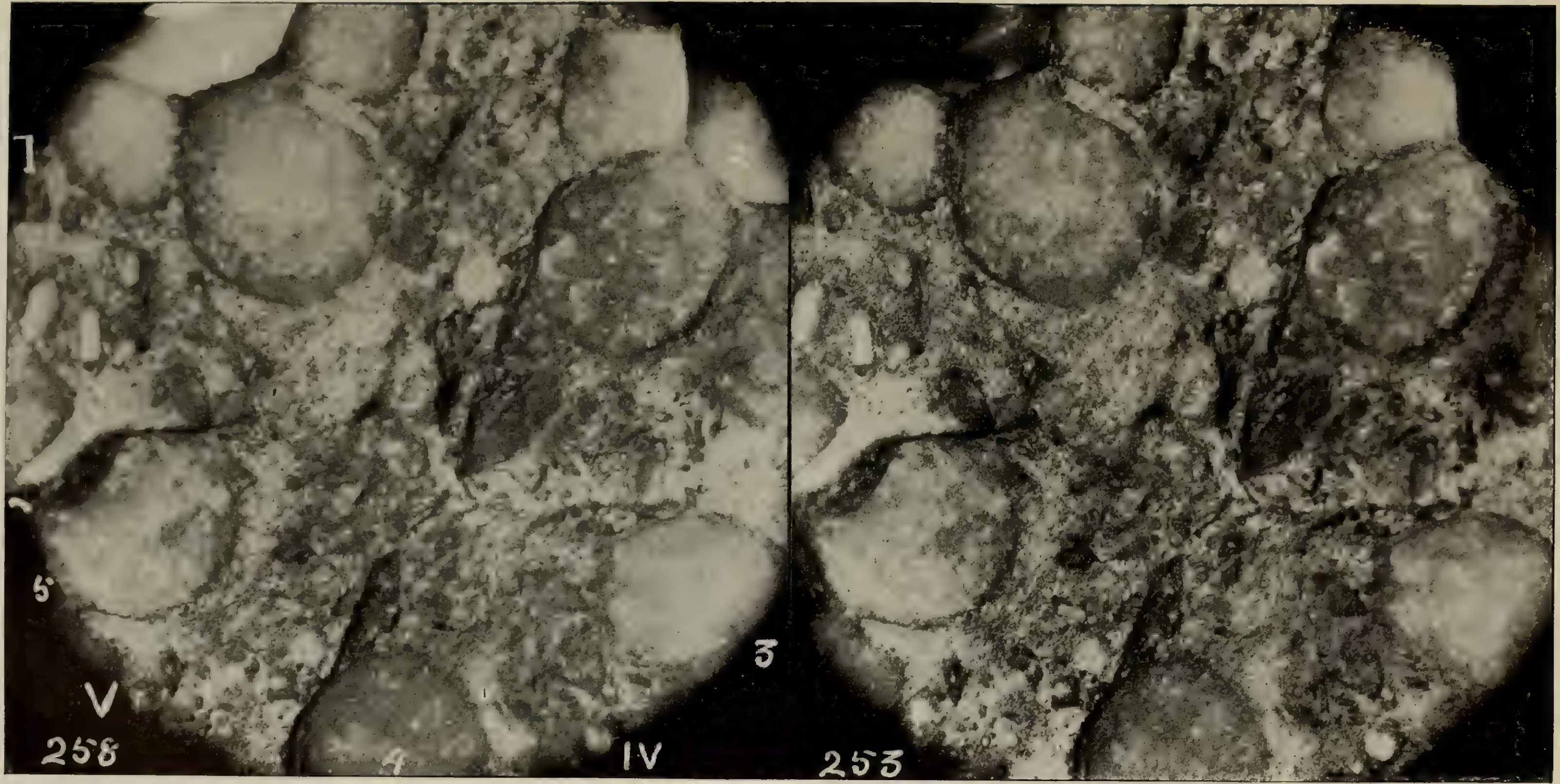
1
5
V
258
4
IV
3
253

Plate 10 P a l a e a s t e r n i a g a r a e n s i s Hall. Detail of the proximal portion of arm III oral aspect under gum x 19 dia.

Note the transparency of the inner portions of the marginal marked (2); the parallelism of fine elongated white flecks over arm at lower left of the plate; the three pointed depressions in upper left of medial line, which may be artifacts; the larger spines in lower half; the border of black fragments around the inner edges of and between the marginals marked (1) and (2); and the medial double row of small spinelets arranged in combs containing some seven or eight each.

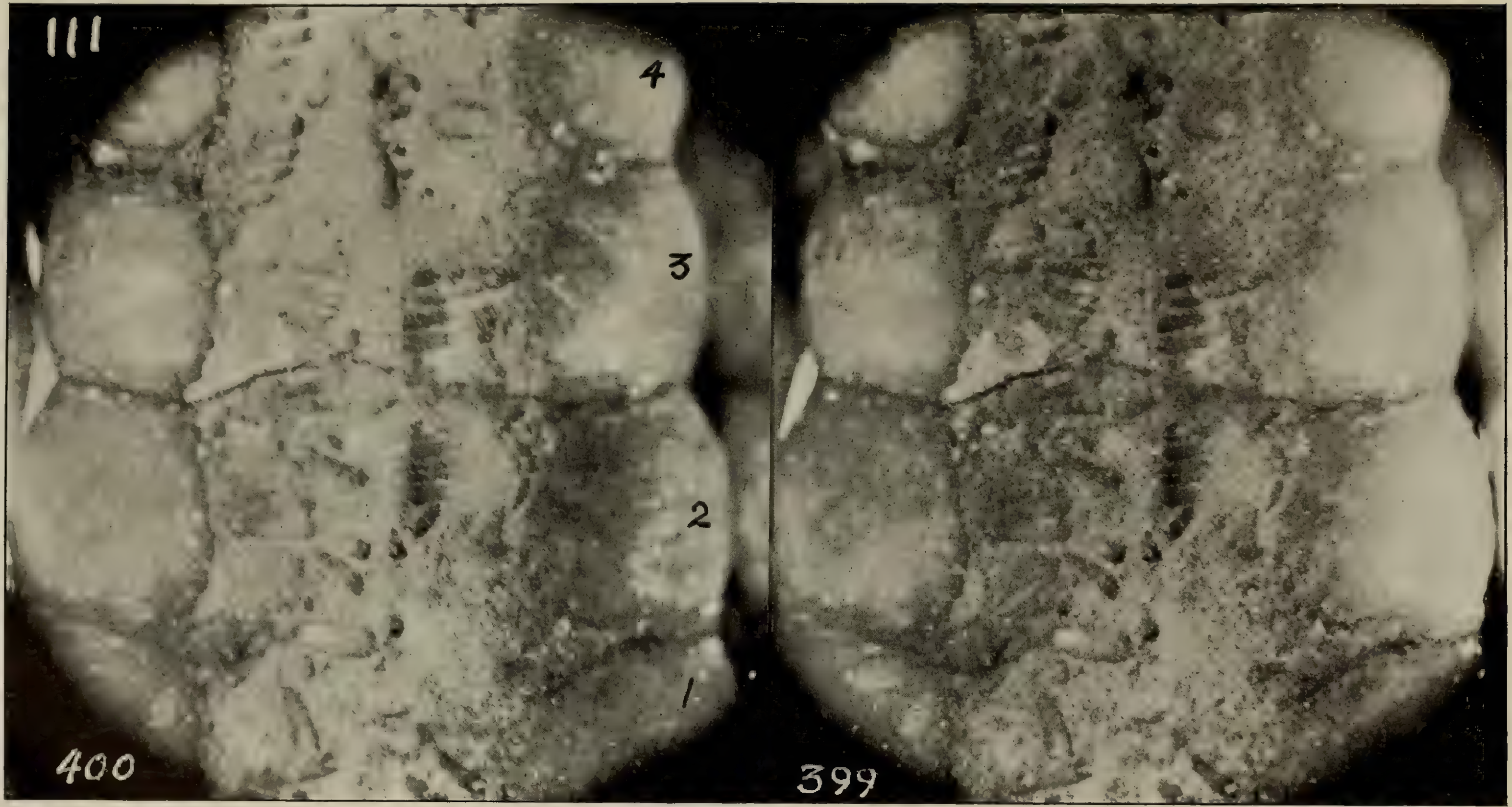
III
4
3
2
1
400
399

Plate 11 Benthopecten spinosus Verrill. Oral view of proximal end of radius IV x 10 dia. Off Delaware, 1186 fms. Museum of Comparative Zoology, Cambridge.

Here again we have evidence for ease and value of comparison of living with fossil forms. According to Professor Schuchert's time table,[1] P. niagarensis lived about 22,000,000 years ago, yet the furrow combs of the present B. spinosus are almost identical in number of spinelets (6 and 7), length, position on the adambulacra, mode of attachment and manner of carrying. In P. niagarensis the spinelets were more slender. The feeding habits were doubtless similar and the specialization through adaption already wonderfully perfect, even in that remote period.

It sometimes happens that a defect in a negative, print, or plate, may introduce a feature or so modify some line, or shading, as to lead to an erroneous interpretation. For instance in the left half of plate 5, interradius 5, the large marginal bears a line due to a scratch received by the photograph after mounting. This is nearly parallel with the lines in the ossicle itself. Its absence from the right-hand half shows it to be an artifact. Two different negatives taken at different angles would hardly introduce errors twice in the same place and could never so introduce them as to produce perfect stereoscopic relief. The very presence of such relief is positive evidence that we are dealing with a true feature of the specimen.

[1] Paleogeography of North America, plate 101.

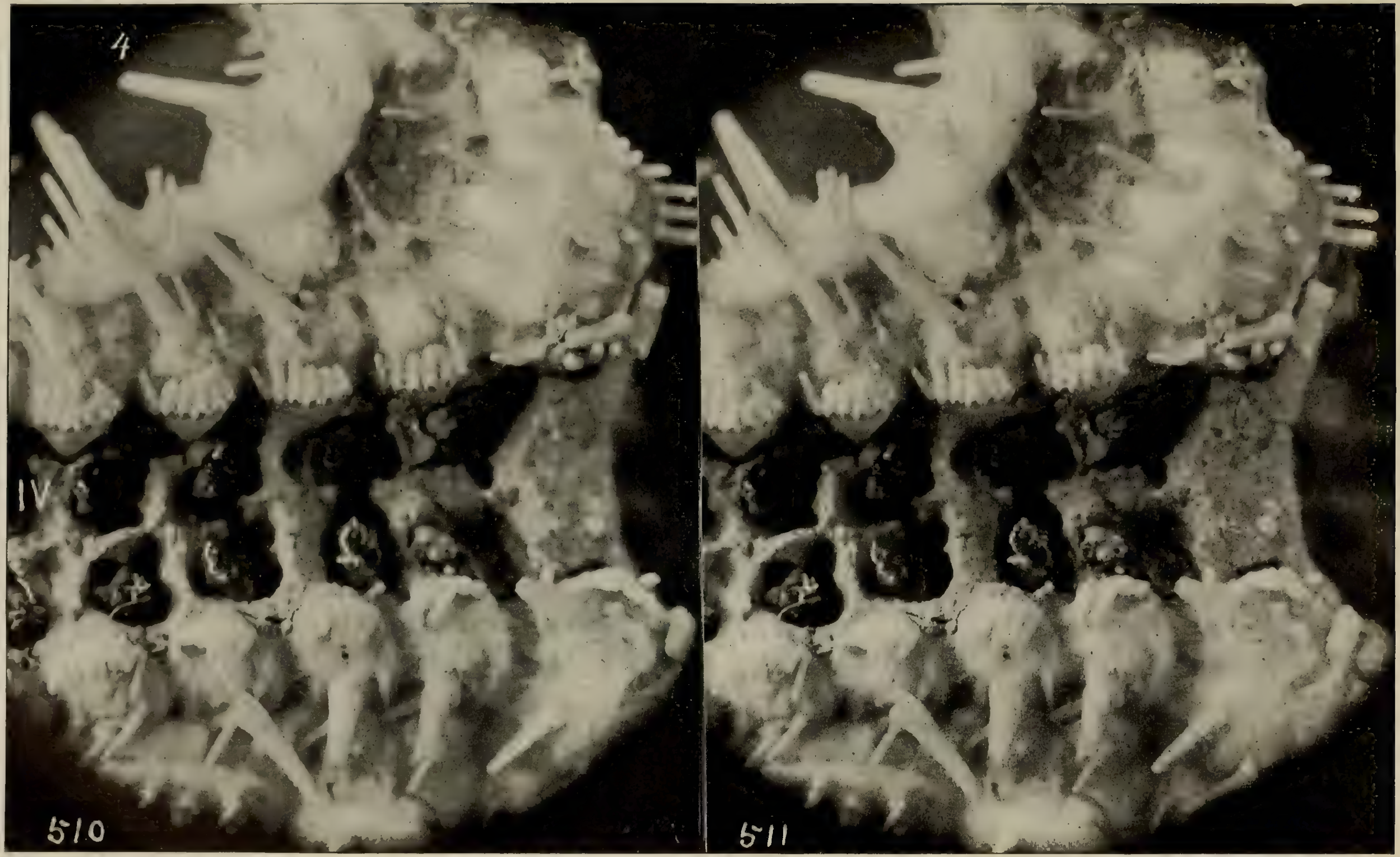
4
IV
510
511

Plate 12 Palacaster niagarensis Hall. Detail, oral aspect of arm V under gum x 19 dia. The adambulacra and the manner of attachment of the furrow combs are here well shown.

As a matter of interest and for the benefit of the art of illustration, we ought to compare this stereogram with Hall's figures 22 and 23 (op. cit.). The plates of Hall's report were beautifully drawn and the lithographic work was of very high character. It is the writer's desire, however, to point out that the best drawings ever made will neither reveal all the artist saw, nor will they reveal anything he did not see. The drawing also emphasizes certain features at the expense of others. On the other hand, the stereogram reproduced without retouching may be made to present all that can possibly be seen and (by modern methods) much that could never be seen otherwise. For example, in Hall's figure 22 the combs have five spinelets only and they are attached to the marginals and project over the furrow. In this stereogram the combs are seen to have seven or eight spinelets, and they are attached to the inner edge of the adambulacra and project away from the furrow.

In these stereograms the author has been enabled to present some items he has seen but they are not distorted to make others see them *from his personal standpoint*. In the same stereograms also there is much that the author has not seen, but which may yet be recognized and found to be of value a hundred years or more hence. Can any form of illustration have a higher, truer or more lasting value?


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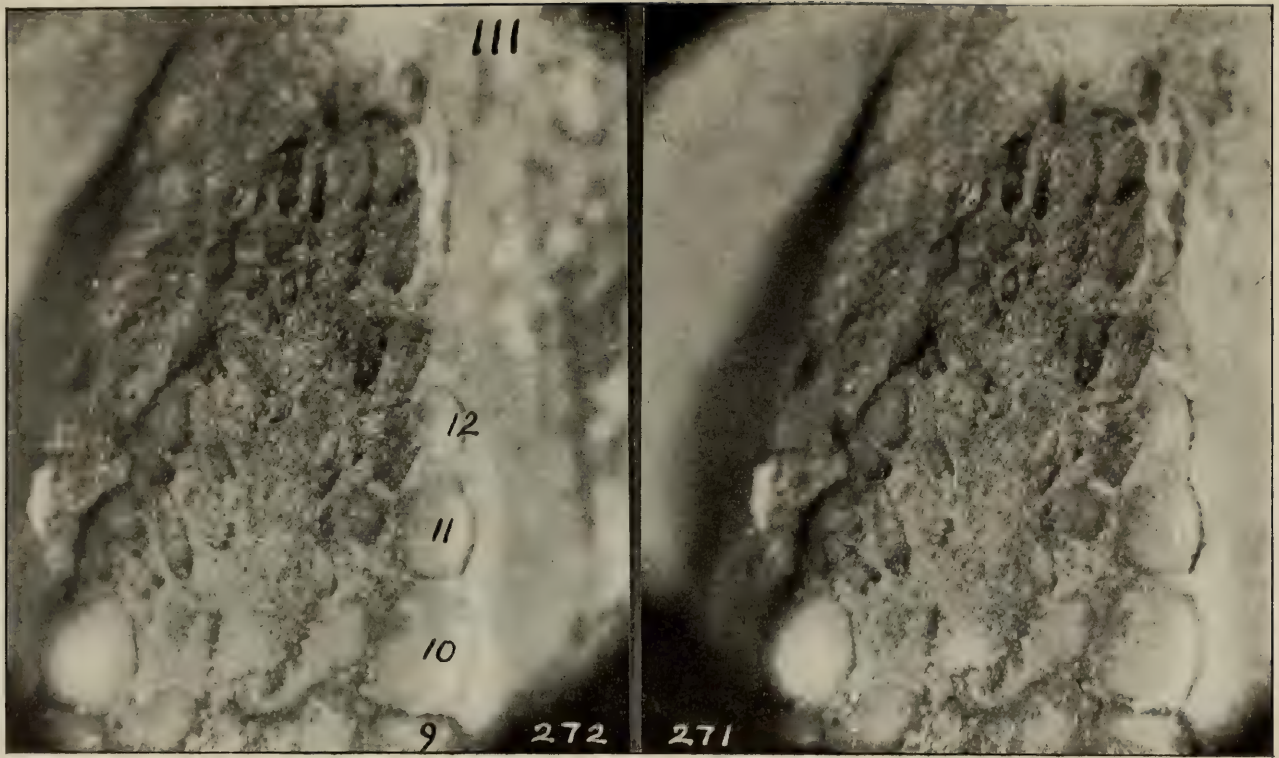
Plate 13 Palaeaster niagarensis Hall. Detail of oral surface of arm III under gum, x 19 dia. It is evident from this stereogram that, in addition to the furrow combs, each adambulacral bore also two larger spines.

The stereograms illustrating P. niagarensis were slected from over forty made of this species. The numbers on the lower edge of the separate halves are the numbers borne by the separate negatives. Those who have kindly loaned material for study have had stereograms sent them and one writes, " I would rather have the stereogram than the specimen." If the type is a mold and therefore useless for development, a good stereogram ought to answer every purpose. The publication of such would therefore tend to render unnecessary the future loans of rare types and at the same time practically bring those types to the laboratories of thousands of students.

In closing I may call attention to the possibilities of penetrating the stone by invisible light waves and so revealing the entire specimen in stereoscopic relief, viewing as it were a transparent ghost of the species with various details of its internal structure. For example, I refer to the successful work of M. Pierre Goby of Grasse, France, in using the microscope in conjunction with such light, notice of which appeared in the Literary Digest, November 16, 1912, page 900. This subject is well worth the attention of paleobiologists.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THE ORIGIN OF THE GULF OF ST LAWRENCE[1]

BY JOHN M. CLARKE

Present-day geography contemplates not only the surface of the earth and its forms of land and water, but considers also the physical and human causes that are modifying it. The geographer sees these things and looks forward; the geologist sees present conditions and looks backward for their inception — and then again forward in the perspective of cause and effect. It is hard to draw the line between these two fields of scientific interest. Some have tried to circumscribe each but it is a bootless effort. Each trenches on the other. At all events every geographer is something of a geologist. And this may be my justification in endeavoring here to find a clue to the origin of a geographic feature of so deep interest to us all as the Gulf of St Lawrence. We are very apt to take such a geographic fact for granted as it is and to let our geography end with a knowledge of its outlines, the contours of its shores and its bottoms. To unravel its history and to find the causes which have brought it into being is a task that will be fruitless on the face of the facts as they present themselves to the maker of charts. The key lies in the geological birth and growth of the whole land mass by which such a body of water is embraced.

So to find the real factors in the making of this classical and romantic body of water, we shall have to go well back to the early events in the making of the land.

Fundamental among these facts is the existence of the great mass of crystalline rocks that sweeps from Labrador to the Laurentides and northwestward to Alaska — the Canadian shield — as a continental land mass rising above the waters of the primitive ocean. Its shores were washed by the first sea whose life records have been kept for us in the sediments which, now changed to shale, sandstone and limestone, bound all its ancient shores. On the south coast of this Canadian continent, in the ages of its independent existence, lay, in the longitude of Montreal, a great tongue or peninsula which forms the Adirondack mountains of New York; and still farther south, perhaps, were long and narrow land masses that kept their uncertain heads above water for no great time. About these con-

[1] Reprinted from Bulletin de la Sociètè de Géographie de Québec, v. 7. January 1913.

tinental and insular shores and on the bottom of these shallow intervening seas were laid down, to hundreds and even thousands of feet, the sediments of the ocean filled with the remains of living beings that played out their days in succession as unknown time rolled by. Thus the shallow sea became overloaded with its burden of deposits — a load of soft and plastic material made still more yielding by being carried constantly farther downward into regions of higher heat as the later deposits continued to pile on top of the earlier. Against this soft and weakened mass of deposits stood, on one side, the great weight of the waters in the vast Atlantic ocean basin, pressing upon them landward, and on the other, the irresistible crystalline continent — the Canadian shield.

The outcome was inevitable; the whole mass of sea deposits was slowly turned up into great mountain folds and troughs — not all at once but slowly, fold after fold, to unmeasured heights, and often the folds at the south were thrust upon and over folds at the north. Thus, broadly and rapidly speaking, the Appalachian system of mountains was built up through the ages, not at any one time in geological history, but beginning slowly and early at the north and ending late at the south. In the early development of this structure the shove of the soft rocks against the crystalline shield was so valiantly withstood at the north, that there, along the southern outline of that shield, from Lake Ontario to Natashkwan, the softer rocks broke down, making, where the two lay in contact, a deep and broad fracture extending from southwest to northeast. The existence of this break or fault in the rocks was long ago signalized by Sir William Logan[1] and it is known today as " Logan's

[1] One who has followed closely in the footsteps of Sir William Logan in his geological work in eastern Quebec may perhaps be permitted, without impropriety, to revert to the extraordinary achievements of this great Canadian, and his distinguished services to geological science.

The year after Sir William organized the Geological Survey of Canada, he began his official career by explorations in the Gaspé peninsula. Laboring in the early 40's among the picturesque sea cliffs of that inviting country, traversing its wildernesses, he determined its geological systems with their wealth of unrecorded facts and made of the Gaspé country ground that will always be of classic worth to geological science. Had he done no more, he would have served well; but he did do vastly more in the development of the mineral resources of the Dominion. A country that is rich and strong and great will not forget its obligation to such a distinguished servant. France, it is said commemorates by public memorials the services of its eminent civilians more often than it does those of its military and naval heroes. Such a memorial to Logan is wanting. There stands a rock cliff in the heart of the

fault." It is beyond doubt the determinant factor in the existence and course of the St Lawrence river. "Logan's fault" gave birth to the river by setting down a line of weakness along whose crushed and broken rock masses the continental waters draining to the sea could find their least obstructed passage; and thus began the oldest of all great rivers of the earth and the oldest of all rivers on the earth of which we have any definite record.

The Appalachians of the Eastern Townships follow the normal northeast-southwest course, but in Gaspé, as every one knows, they swing about into a curve like a swan's neck or the upper line of the letter S. There the northern mountains end at Cape Gaspé on the land but their vanishing point can be followed some fifteen miles off to sea southeast, to the rocky shoal known on the charts as the "American bank." This mountain ridge or orogenic axis at the north is unlike that of the Appalachian ranges at the south. The ridges of these ancient mountains cross Nova Scotia in the normal trend; their southwesterly extension off New England is largely buried beneath the sea, and to the northeast they continue on their course across Newfoundland. Looking at the sketch map adjoining, one sees the different curves of these mountain axes at north and south and between them an area which we must believe was less involved in the profounder or axial movement of these disturbances — the region of central and northern New Brunswick. We are speaking of times and conditions when there was no Gulf of St Lawrence, when the elevation of the mountains had brought, if not quite all, at least most of the land now at the bottom of the gulf, above the water line and the continent extended without break from the present eastern shores out to the islands and across to Newfoundland. For long this ancient coast line was a series of mountain folds between which the ocean waters entered in broad channels southwestward, laying down the deposits of their own time in their due succession. But from the time the most ancient of these mountain folds were made, when the ridges at the north took on their singular curvature, the whole area between their end and the mountain axes to the south became an area of weakness and instability. This sigmoid curve at the north is a factor of profound meaning in the making of the gulf. It seems to be due to

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village of Percé, overlooked on one side by towering sea cliffs and on the other by consecrated mountains over which Logan labored in his early work, and here might well be placed a tablet commemorative of the lasting achievements of his great career.

the recoil, as one might say, of the softer rocks in their pressure against the irresistible Canadian shield, so that the line of fracture or fault was deflected at its outer end southward in such a way as

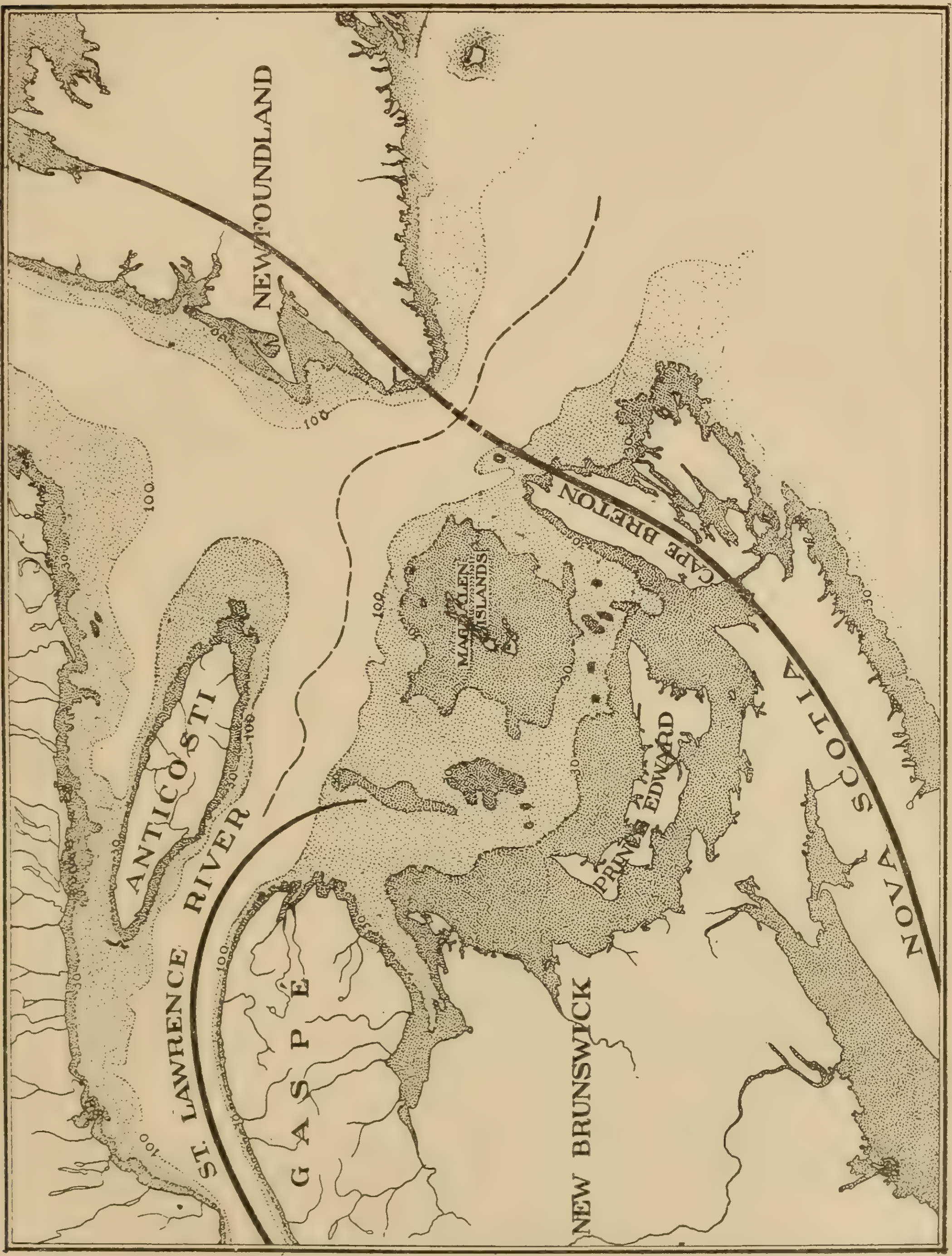


Chart of the Gulf of St Lawrence and adjoining lands

(The areas of the bottom down to 30 and 100 fathoms are indicated by close and coarse stippling. The broken curved line through the gulf is the line of greatest depth. The heavy black lines are the orogenic or mountain axes at north and south.)

to break through the mass of sedimentary deposits. Thus the St Lawrence river has almost of necessity an outer curve that follows the course of the fault and of the folded slate and limestone mountains of Gaspé, while to the north of the fault line and the buried river channel lies the island of Anticosti whose rock strata, full of fossils, lie almost horizontal and were beyond the influence of the mountain making.

This revulsion from the north projected the axial line of resistance southward against the normal course of the other folds and protruded into them a disturbing antagonistic force. The Nova Scotia anticlines were beyond the reach of this projected influence but the folds between were disordered and crosscut and weakened. The picturesquely ragged coast at Percé is due to a complete collapse of a tremendous mountain fold which has vastly deranged the original succession of the rock strata.

The gulf lands had sunk low soon after the mountain-making period was over, and during the succeeding times of the Coal and probably even before, it was chiefly a vast drainage basin receiving fresh land waters with their heavy loads of sediment, then again elevated into a sand desert or great stretches of bars and dunes, and still at times depressed again so that the salt waters came in bringing their characteristic life forms. Then again, in later geological days, after the day of the Coal and the sand bars was over, the region was again elevated into land and the rocks of that land still fringe the gulf shores and make the islands of Prince Edward and the Magdalens.

The submarine course of the St Lawrence river across the gulf is still clearly indicated on the Admiralty charts; from its present mouth southeast it extends, far to the east of Gaspé, east of the Magdalen islands and thence outward to the Atlantic by the passage between Cape Breton island on the west and Newfoundland on the east (Cabot strait). This valley was made when the gulf bottom was land.

The chart accompanying shows the curves of 30 fathoms and 100 fathoms. It is very clear that the deep channel outside the 100 fathom line could not be made by the scouring of the present stream over the rocky bottom of the gulf. A more detailed chart of the gulf would show these depths dropping off from the shore in a succession of stages, or one might say terraces indicative of the gradual and periodical rise of the land bounding the ancient river while the river itself was cutting downward and narrowing its

channel as the gulf lands rose. It is not to be conceived that this channel through the gulf is as ancient as the channel between the shores of Gaspé and the Quebec Labrador. The lands which the lower channel cuts are of later birth than those at the north and in its earlier stages we may believe that the river debouched into a shallow sea much as it does today into the gulf. The student of the chart will observe that there is a branch channel leading off in the direction of the Strait of Belle Isle but it is a shallower trough than that to the southeast. The line of deepest water is in the southeast channel and there is a difference in maximums of depth between the two of 155 fathoms, the greatest depth in the northwest trough being 145 fathoms and in the southwest 300 fathoms.

The southeast channel drops quite steeply 1700 feet below the broad 100 fathom plateau and this is twice the depth of the northeast course.

It would seem that the northeast course was a river valley of earlier date than the southern part of the southeast channel, that the river abandoned it for sufficient cause, possibly change in submarine level or blockage by a heavy ice sheet, and then continued to erode its present buried channel to still greater depths.

The courses of existing submarine currents over this region are not yet sufficiently determined to permit us to speak definitely regarding the outpush of the waters through the southeast channel and yet it is practically certain that this is the predominant trend of the major deep water movements of the gulf.

The Gulf of St Lawrence thus owes its existence chiefly to two determinant factors of very ancient date: the breakdown of the rocks which produced "Logan's fault"; and the curvature of the northern orogenic axis which effected a syntaxis or a protrusion of the northern against the southern Appalachian folds. The broken down basin between is a natural and resultant area of rock weakness which has had its short periods of low elevation above the sea, but longer periods of depression.

A NOTABLE TRILOBITE FROM THE PERCÉ ROCK

BY JOHN M. CLARKE

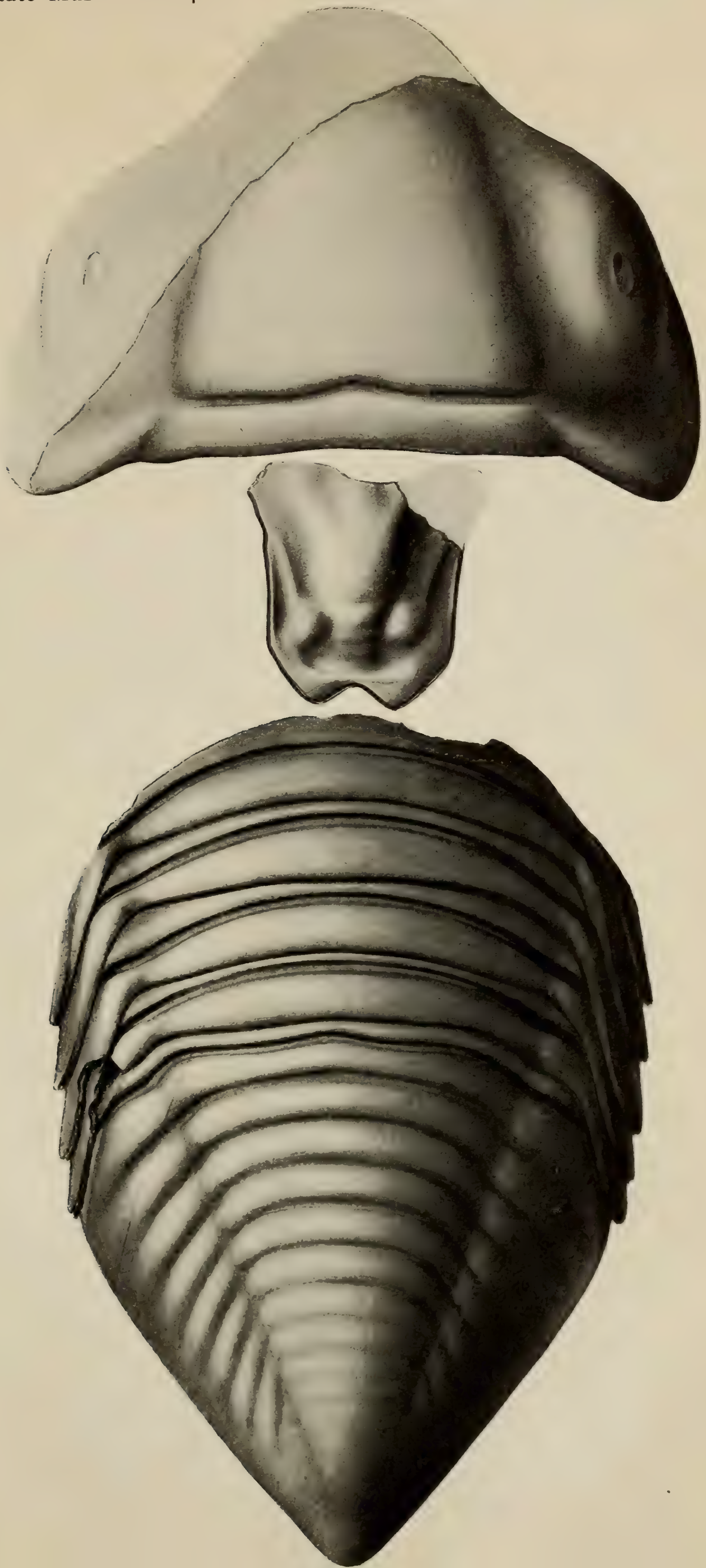
The list of Lower Devonic species occurring in that spectacular cliff L'isle percée or Percé rock, has been given by the writer with some degree of fulness in his volume on the geology of Gaspé (N. Y. State Mus. Memoir 9, part 1, 1908). Among these species several trilobites of interest have been described. These accounts were based upon the collections made during several seasons of diligent work, and subsequent search has not materially added to the census of the fauna. The past summer, however, brought to light two specimens of a commanding Homalonotus, a genus not hitherto recorded from any of the Devonic outcrops in Gaspé county, and not only its presence but the character of the species itself is worthy of note.

The Homalonoti of the boreal Paleozoic regions in America are distinctively characterized by their freedom from dermal overgrowths. They carry no spines or tubercles on any part of the test. This is a statement subject of course to the limitations of our pretty considerable knowledge of the Paleozoic faunas on this continent and while applicable here, it can not be so broadly stated for the boreal Palezoic, particularly Devonic, Homalonoti of the eastern hemisphere. There are European species of which the Siluric H. knighti and the Devonic H. armatus are leading and almost sole examples, whose test is spiniferous or tubercled, while the predominant species are devoid of these growths as in America.

The armate Homalonoti are on the whole quite distinctively austral, especially in their Devonic distribution. Witness of this is the great abundance of H. herscheli Murchison in the South African Lower Devonic[1] and at the same horizon in the Falkland islands.

There is an abundant and often beautifully preserved species in the Lower Devonic shales of São Paulo, Brazil, termed by the writer H. noticus, which is free of spines save for one conspicuously developed on the epistoma, a structure which is present in H. herscheli, but absent in all boreal species.

[1] The large number of species of this genus described by the writers on the South African Devonic has seemed to me not justified by evidence, except for provisional purposes.



The species under present consideration conforms in these structures to other American Homalonoti and is to be directly compared with H. vanuxemi of the New York Helderberg and H. major of the New York Oriskany, accounts of which are to be found in Palaeontology of New York, volume 7. This resemblance is not unexpected in view of the many other affiliations of the Percé and Grande Grève Lower Devonic faunas with those of New York. The Percé Homalonotus is represented by specimens which indicate its large size. The largest known example of H. vanuxemi is a broken individual from Rondout, N. Y., and indicates an animal 280 mm in length, which is almost exactly the proportions of the Percé species. But even so large, these specimens fall far below the dimensions of H. major, the largest of all members of the genus. Yet there are, between these two species, few differences except dimensions, habitat and geologic horizon. In structure they are closely alike, the smaller H. vanuxemi occurring in the Helderberg limestones and lime shales and H. major in the Oriskany silicious limestones. The Percé species is rather better preserved and now better known in its details than either of the New York species mentioned, but its designation must show its affinity to them even at the cost of a multiplex name. I therefore venture so far as to express this relationship by the designation Homalonotus (v.-m.) perceensis.

The structure of the parts is indicated in the drawings which show the pygidium in normal convexity and entire, six of the eleven thoracic segments (all are preserved on a second but somewhat worn example), the head, partly worn away and the hypostoma. The obscurity of segmentation of the pygidium is characteristic and differential from other Devonic species, especially the common middle Devonic H. dekayi. The cephalon of H. vanuxemi-major has not been well made out and the hypostoma of this type is now seen for the first time, both of the Percé specimens showing this organ.

The author has shown the presence of H. vanuxemi in the Lower Devonic Moose River formation of Maine at Matagamon and Moosehead lakes.[1] Until now no representative of the genus has been known from points farther north.

[1] N. Y. State Mus. Mem. 9, v. 2, p. 67.

ILLUSTRATIONS OF THE DEVONIC FOSSILS OF SOUTHERN BRAZIL AND THE FALKLAND ISLANDS

BY JOHN M. CLARKE

Three years ago the writer completed a protracted series of studies on the Devonic faunas of South America, especially those of southern Brazil in the state of São Paulo, and of the Falkland islands, incidentally also of the Cordilleras of western Argentina. These studies were authorized by the director of the Geological Service of Brazil, and the full discussion of these austral faunas is in course of printing as a memoir of that organization. Meanwhile, because of the delays attendant on publication in Brazil, and by permission of the director of the Brazilian Survey, occasion is here taken to present illustrations of the leading species of the Brazilian and Falkland faunas which are with propriety incorporated in this report on account of their intimate but contrasting relations to the Devonic faunas of New York.

While no other purpose is here sought than to set forth, as well as may be by illustration, the distinctive fossil characters of this southern Devonic and the whole estimate of the real significance of the fauna must be reserved for its more complete presentation and discussion, it is well to intimate that these Devonic faunas of the south and of the north, though united by general characters, are keenly and widely separated in the analysis of their specific and superspecific structures. This fact makes itself so clear that it is evident the northern and southern faunas developed in separated basins with but restricted intercommunication during the Devonic. These illustrations also indicate the continuity of the strand line and of the Devonic continents from southern South America to the Falkland islands and thence to South Africa.

EXPLANATIONS OF PLATES

Plate 1

Homalonotus noticus Clarke

(See plate 2)

Fig. 1, 2 Dorsal and profile views of an extended complete individual of mature dimensions. This is essentially an internal cast, showing approximate normal convexity. The epistoma is exposed and the place of the anterior apiculus seen.

Locality: Ponta Grossa, São Paulo. Brazil

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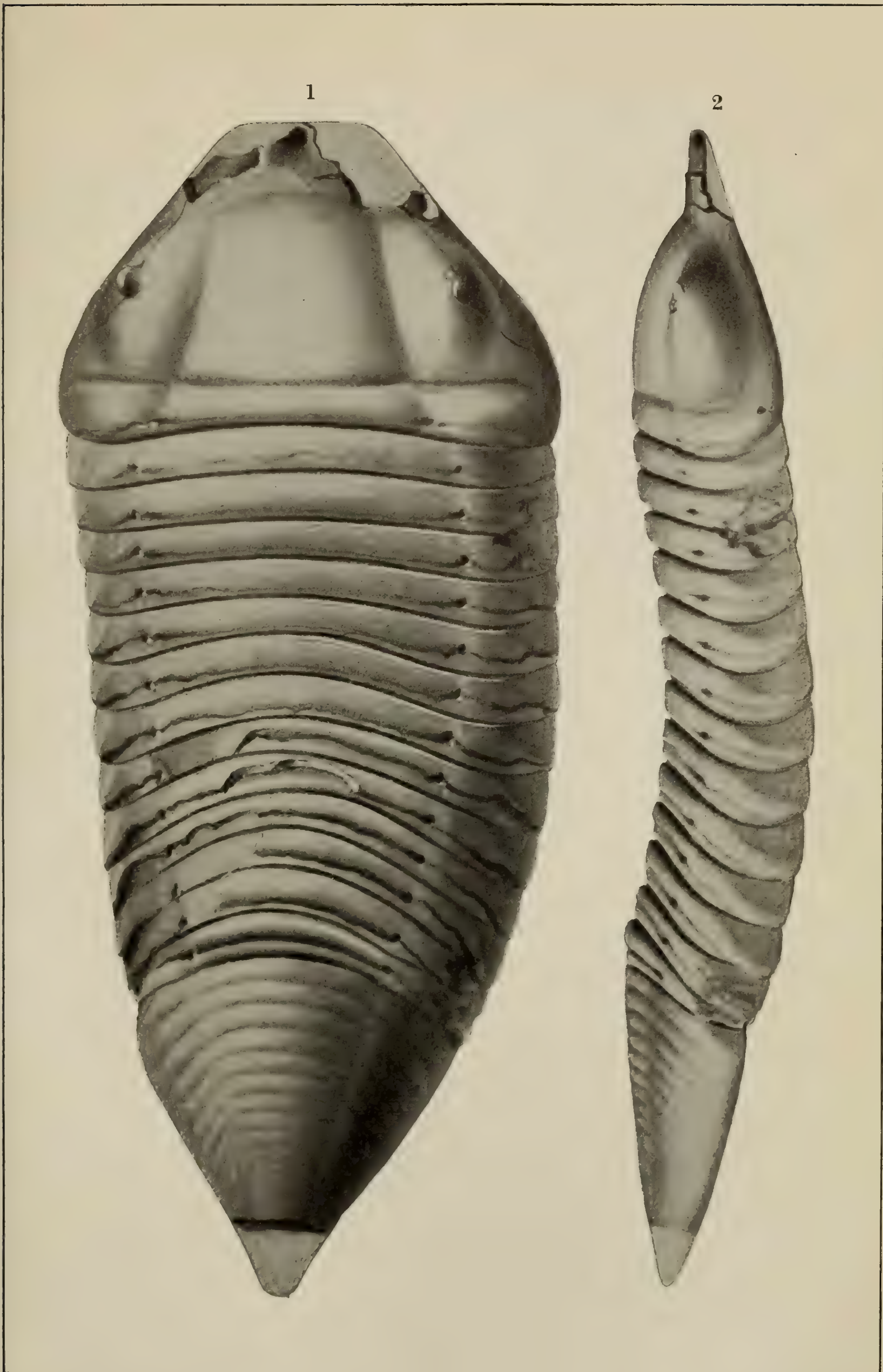

Plate 2

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Homalonotus noticus Clarke

(See plate 1)

Fig. 1, 2 Nearly entire small individuals
3 A large cephalon
4 The anterior doublure, epistomal plate and apiculus
5 A head with part of the anterior removed to expose the doublure and epistomal plate
6 An entire cephalon with apiculus
Locality: Ponta Grossa, São Paulo, Brazil

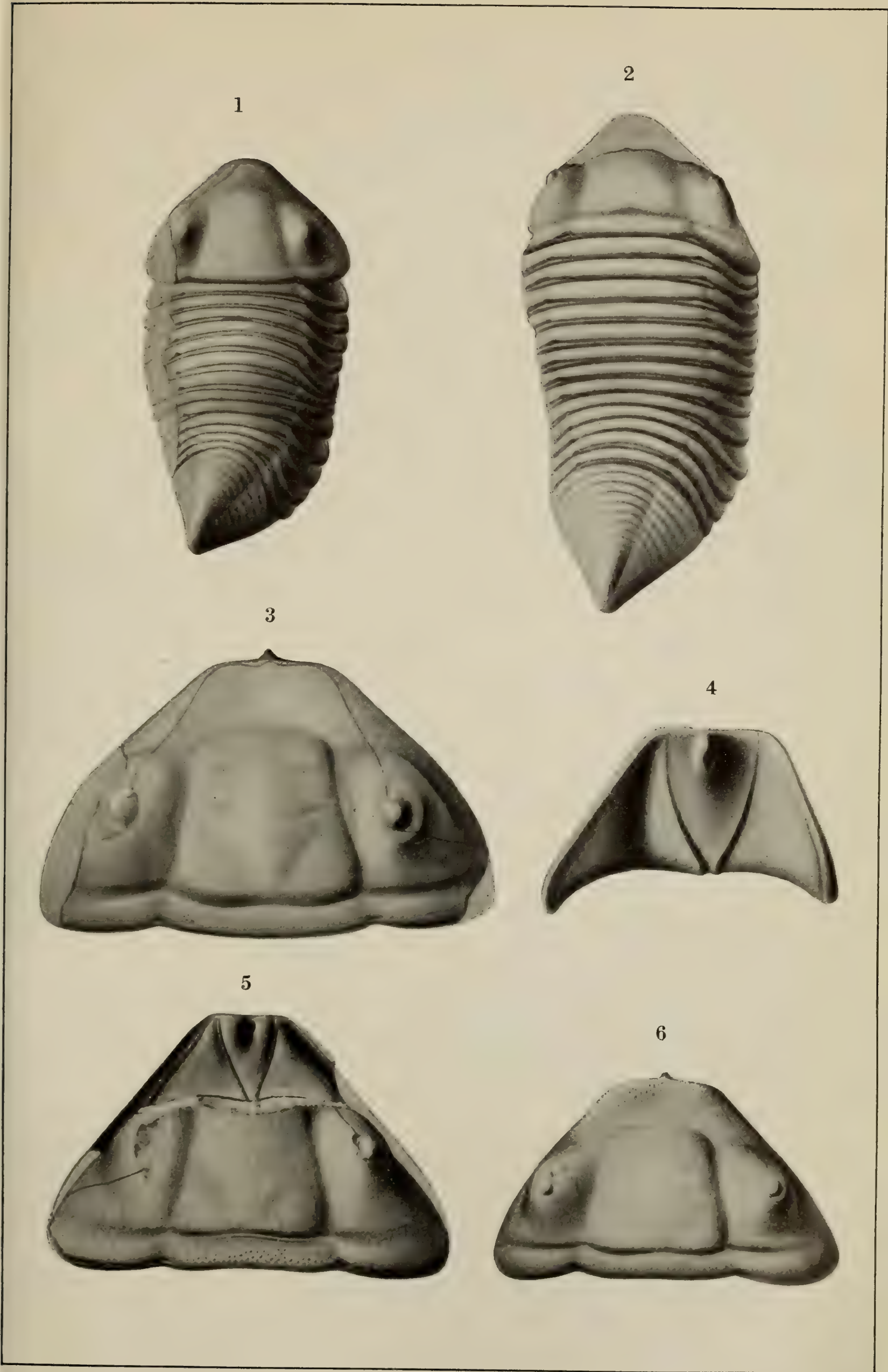

Plate 3

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Homalonotus (Schizopyge) parana Clarke

Fig. 1 Pygidium and a few thoracic segments
2 A pygidium apparently lacking one segment
Locality: Tybagy, São Paulo, Brazil

Homalonotus herscheli Murchison

Fig. 3 A small head with apiculus and scattered tubercles
4 A series of strongly pustulose thoracic segments
5 A pygidium with a few tubercles
6 A large cephalon, nearly entire, of characteristic form, with spinous tubercles at the genal angles and traces of others on the glabella
Locality: the calc-nodules of Pebble island, West Falkland

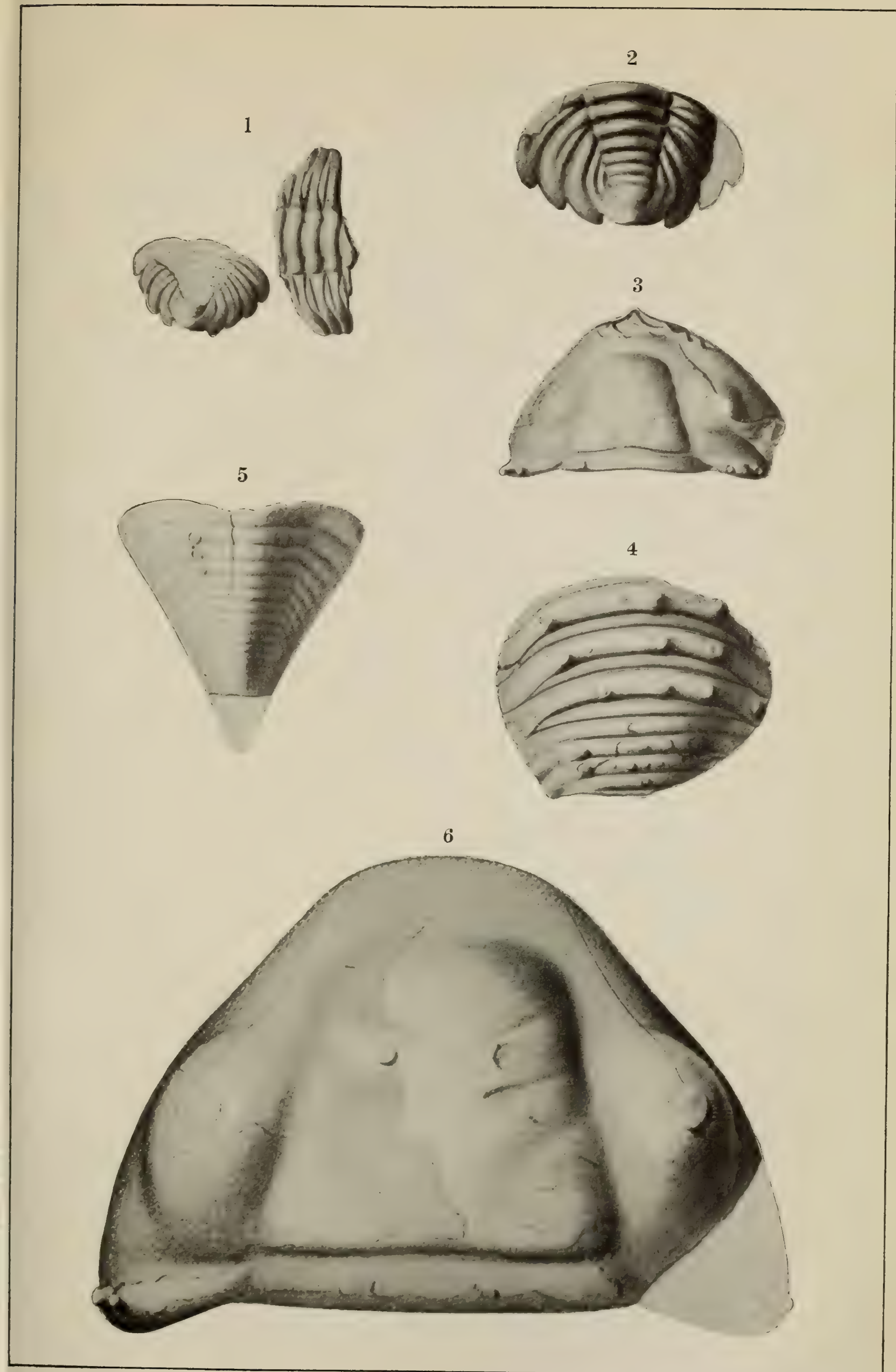
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Plate 4

Dalmanites acacia Schwarz

Fig. 1, 2 Cephala showing the finely granulate surface, small eyes, nuchal spine and slight anterior projection

3, 4 Lateral and dorsal views of thorax and pygidium, showing the length of the erect thoracic spines

Locality: calc-nodules of Pebble island, West Falkland

Dalmanites falklandicus Clarke

Fig. 5 A normal cephalon with large eyes, short cheek spines and coarsely pustulose pygidium

6 Thorax and pygidium of this species

Locality: Fox bay, West Falkland

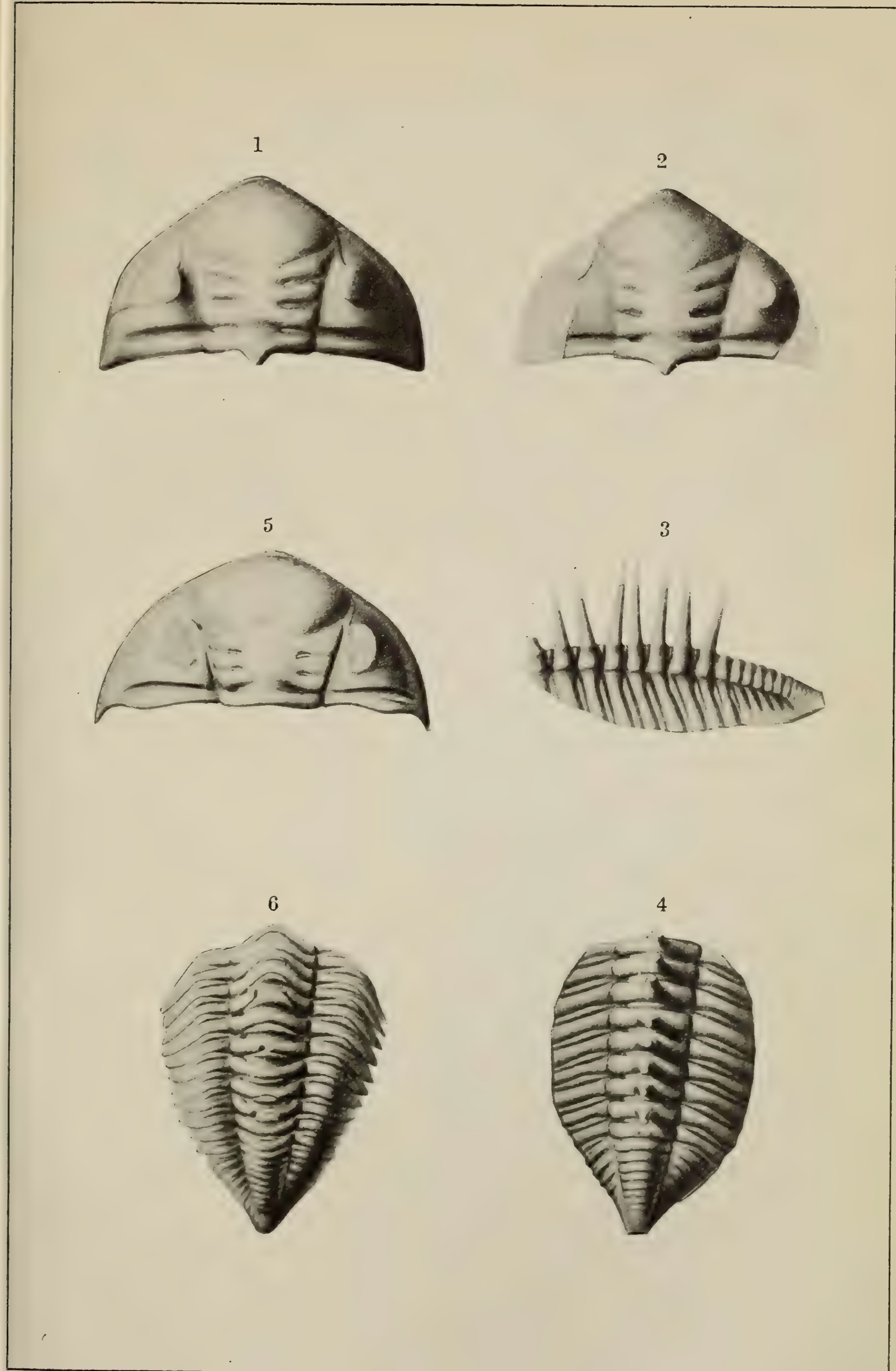
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Plate 5

Dalmanites accola Clarke

Fig. 1 A nearly complete cephalon
2 A small entire cephalon with long genal spines
3, 4 Pygidia showing the uniform distribution of the pustules
5 An incomplete but undistorted individual with the missing parts restored in outline and showing their mutual proportions, arrangement of the scattered pustules, length of genal spines, size of eyes, etc.
Locality: Ponta Grossa, São Paulo, Brazil

Cryphaeus ? allardyceae Clarke

Fig. 6 A somewhat weathered head and a thorax with pygidium from a calc-nodule. The association of these parts, though found disconnected, seems highly probable in view of their being the only fossils in the nodule and of their agreement in size
Locality: Pebble island, West Falkland

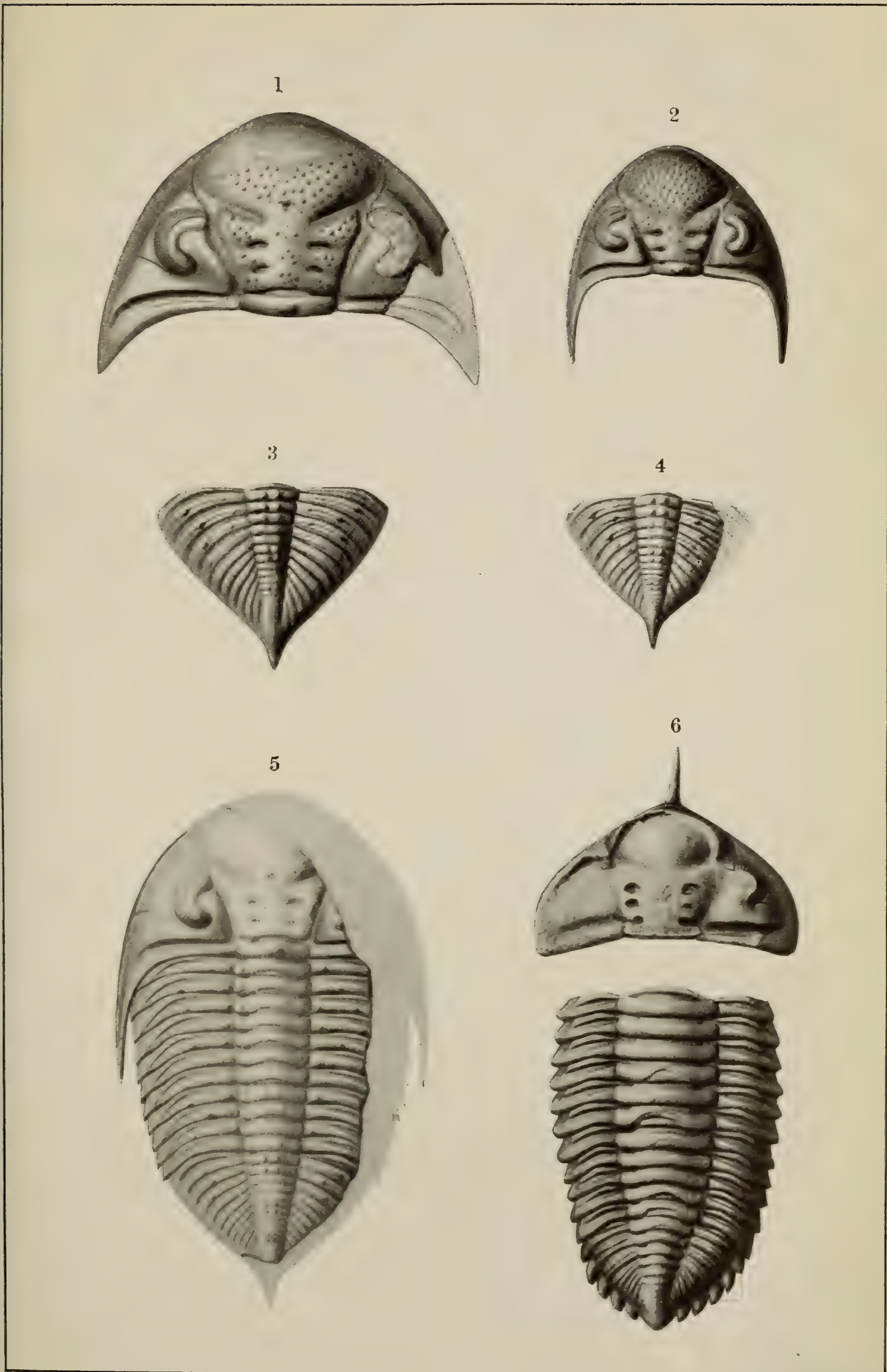
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Plate 6

Cryphaeus sp. nov.?

Fig. 1 A pygidium with very blunt semicircular lappets, indicating a species distinct from the others here noticed.
Locality: Ponta Grossa, São Paulo, Brazil

Cryphaeus australis Clarke

Fig. 2 A pygidium
3 A specimen displaying most of the parts except the pygidial fringe and showing the phacopid hypostoma
4 A nearly entire specimen
5, 6 Larger individuals partly crushed but restored in outline
Locality: Ponta Grossa, São Paulo, Brazil

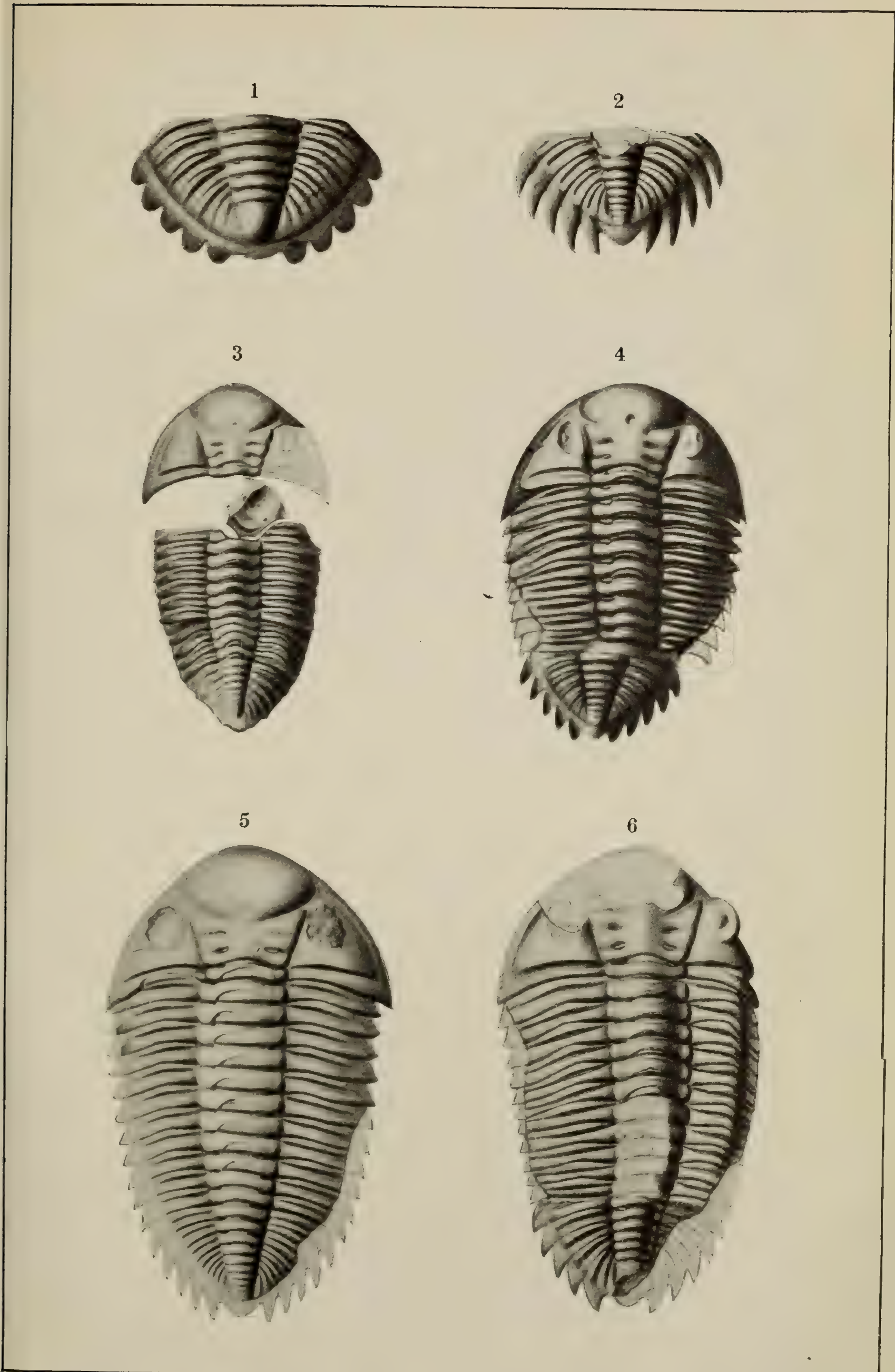
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Plate 7

Dalmanites sp.

Fig. 1, 2 Dorsal and profile views of a cephalon allied to D. acacia and D. ocellus but departing in some structural details. The upturned genal angles are indicated in figure 2

Locality: from a calc-nodule sent to me by Prof. J. B. Woodworth with the note that it was found by Dr Thomas A. Barbour on the old beach of Lake Titacaca at Viacha, Bolivia, elevation 13,500′ A. T.

Calmonia ocellus (Lake)

Fig. 3, 4 Dorsal and profile views of a partly enrolled specimen

5, 6, 7 Three views of a coiled individual showing the characteristic head, small eyes, sharply pointed thoracic segments and a part of the pygidial fringe

Locality: Pebble island, West Falkland

8 An extended specimen incomplete at the pygidium

Locality: Mt Robinson range, Chartres river, West Falkland

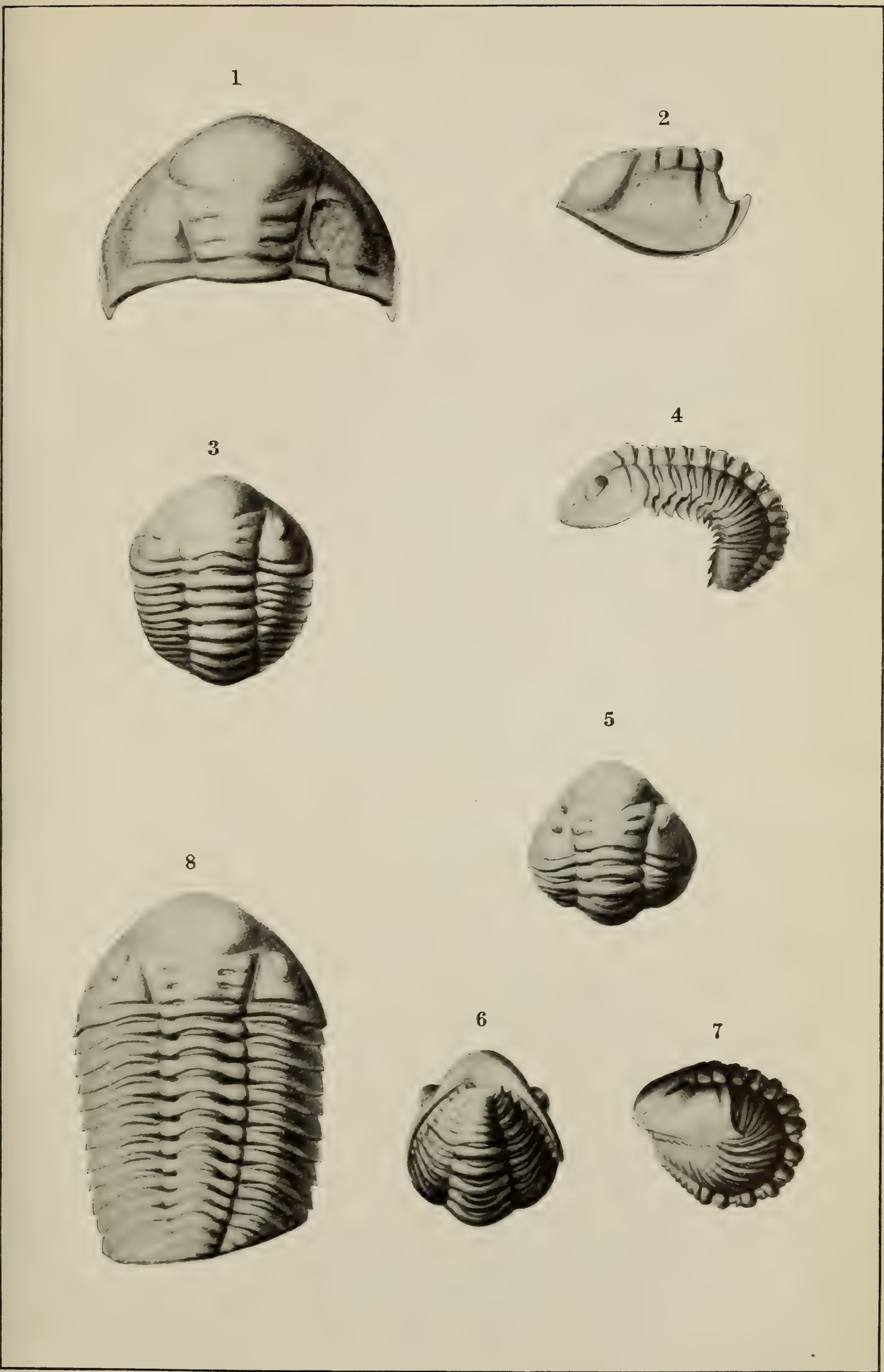
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Plate 8

Pennaia pauliana Clarke

Fig. 1, 2 Cephala
3 A pygidium with two thoracic segments attached. x 3
4 The thorax and pygidium, showing the rounded ends of the anterior thoracic segments and 3 lappets of the pygidium
5 A nearly entire individual restored
6 Thorax and pygidium of an incomplete specimen
Locality: Ponta Grossa, São Paulo, Brazil

Calmonia signifer Clarke

(See plate 9)

Fig. 7 Cephalon restored, showing style and position of the eyes and the small cheek spine
8 Anterior structure of the head showing the short apical projection which is often obscured
9 Internal cast of thorax and pygidium
10, 11 Pygidia with terminal spines
Locality: Ponta Grossa, São Paulo, Brazil

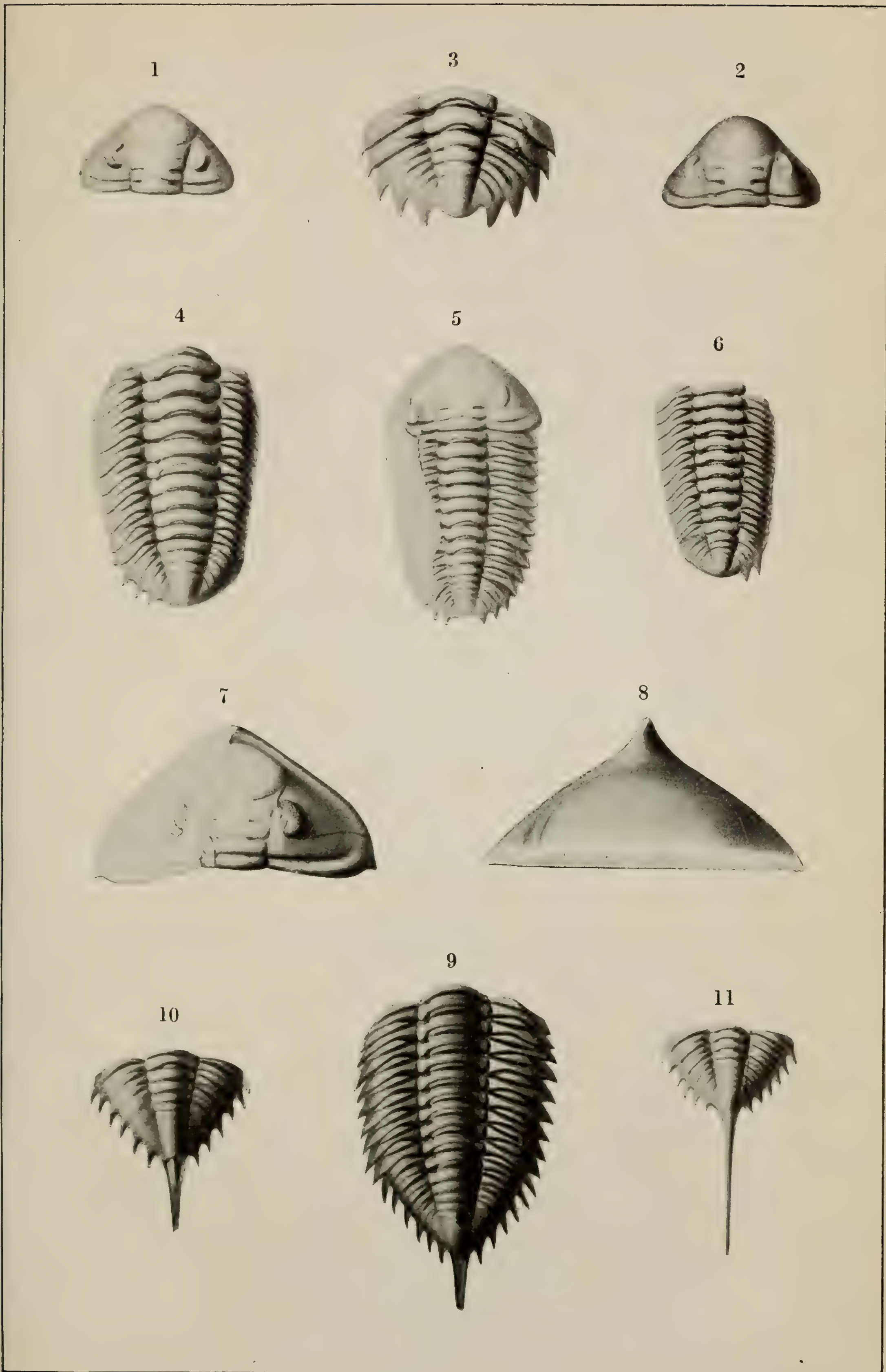
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Plate 9

Calmonia signifer Clarke

(See plate 8)

Fig. 1 A large entire individual in which all the essential characters are well displayed. Attention may be directed to the short head, obscurely lobate glabella, small anterior eyes, angled extremities of the segments becoming sharper backward, the six pairs of pygidiae lappets and the relatively short caudal spine

2 A smaller entire individual with exsert genal spines and a longer caudal spine. The thoracic segments are only ten and one seems to be buried at the junction with the pygidium

3 Head and thorax

4 An entire but somewhat distorted specimen

Calmonia signifer var. **micrischia** Clarke

Fig. 5 A small entire individual

6 A larger entire example

Locality: Ponta Grossa, São Paulo, Brazil

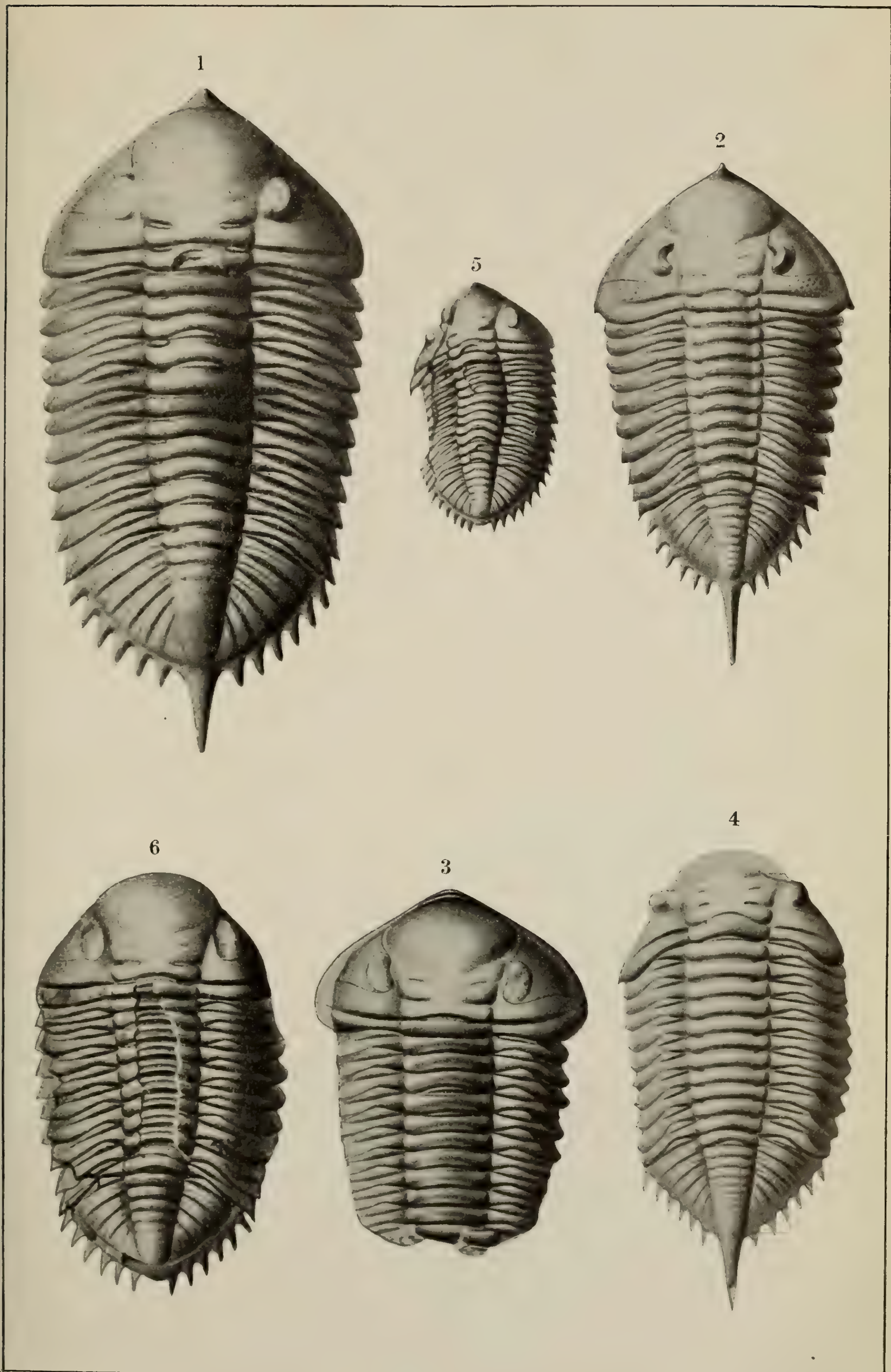
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Plate 10

Calmonia subseciva Clarke

Fig. 1 An extended specimen from which the cephalon has been broken

2 A squeeze taken from the foregoing, showing the cephalic doublure and phacopid hypostoma. x 2

Locality: Ponta Grossa, Brazil

3 An entire specimen, slightly crushed about the head, showing the minute pygidial lappets

4 A nearly entire individual of large size

Locality: Jaguariahyva, São Paulo, Brazil

Proboloides cuspidatus Clarke

Fig. 5 A small cephalon

6 A laterally crushed specimen displaying a part of the proboscis, the sutural and genal spines and the acute spinules of the first thoracic segments

7 A cheek with sutural and genal spines. x $1\frac{1}{2}$

8 A cephalon with its long proboscis, showing also the genal spine and base of the sutural spine

9 Large cephalon with proboscis broken

Locality: Ponta Grossa, Brazil

Proboloides pessulus Clarke

Fig. 10 A specimen with all parts conjoined; showing the aspect of the head, its proboscis and sutural spines, the sharply terminated thoracic segments and apparently smooth margined pygidium

Locality: Jaguariahyva, São Paulo, Brazil

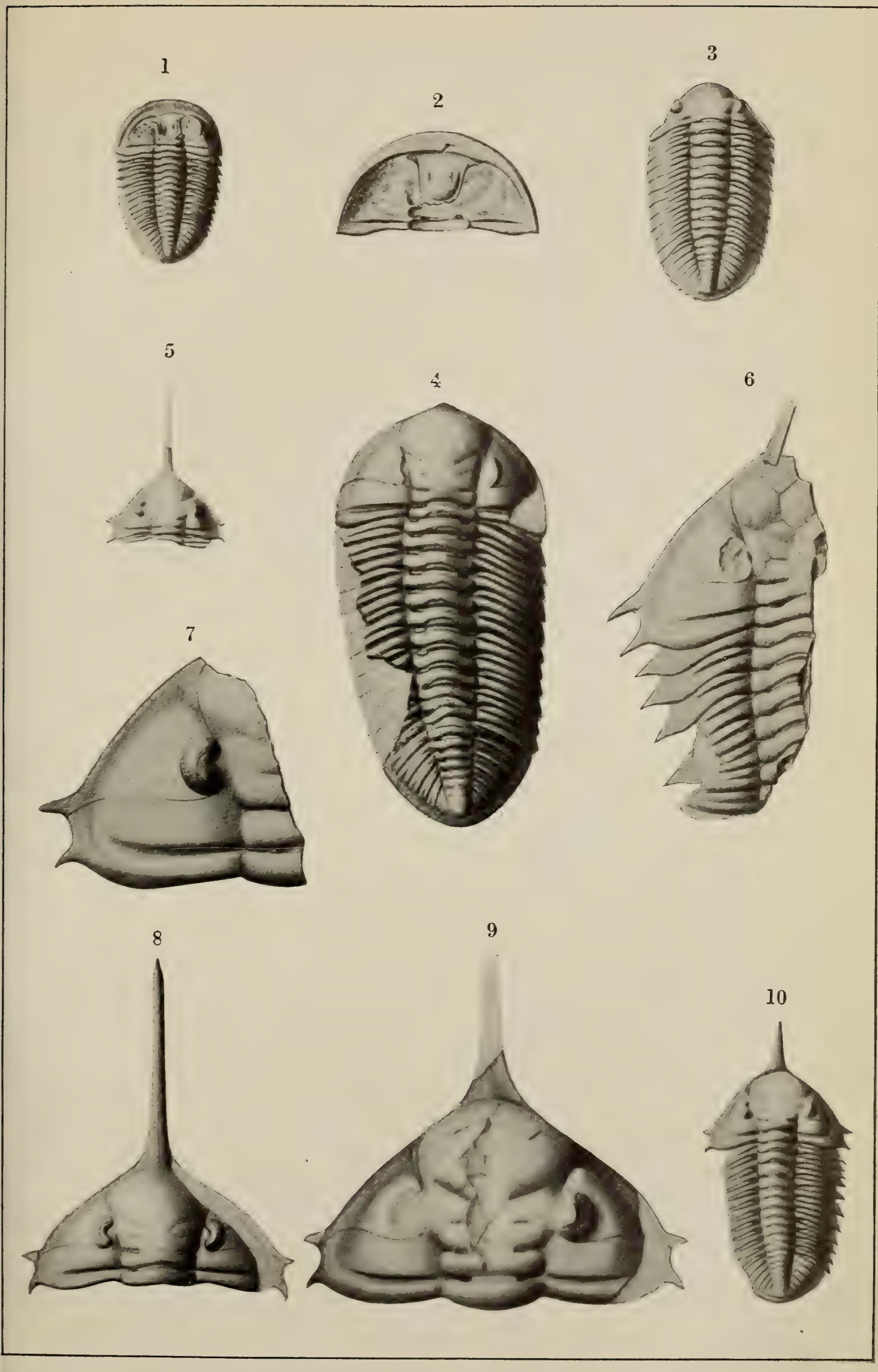
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Plate 11

Conularia ulrichana Clarke

Fig. 1 Enlarged fragment showing nature of ornament
2 A small example. x 2
3 A characteristic example
Locality: Tybagy, São Paulo, Brazil

Conularia africana Salter

Fig. 4 An undistorted fragment
5 A well-developed, nearly entire specimen
Locality: Ponta Grossa, Brazil

Hyolithus subaequalis (Salter)

Fig. 6, 7 The two sides, with operculum in place
Locality: Tybagy, São Paulo, Brazil

Orthoceras sp. (cf. **gamkaensis** Reed)

Fig. 8 Part of a shell retaining fine concentric surface ornament
Locality: Ponta Grossa, Brazil

Kionoceras zoilus Clarke

Fig. 9 The only example observed
Locality: Ponta Grossa, Brazil

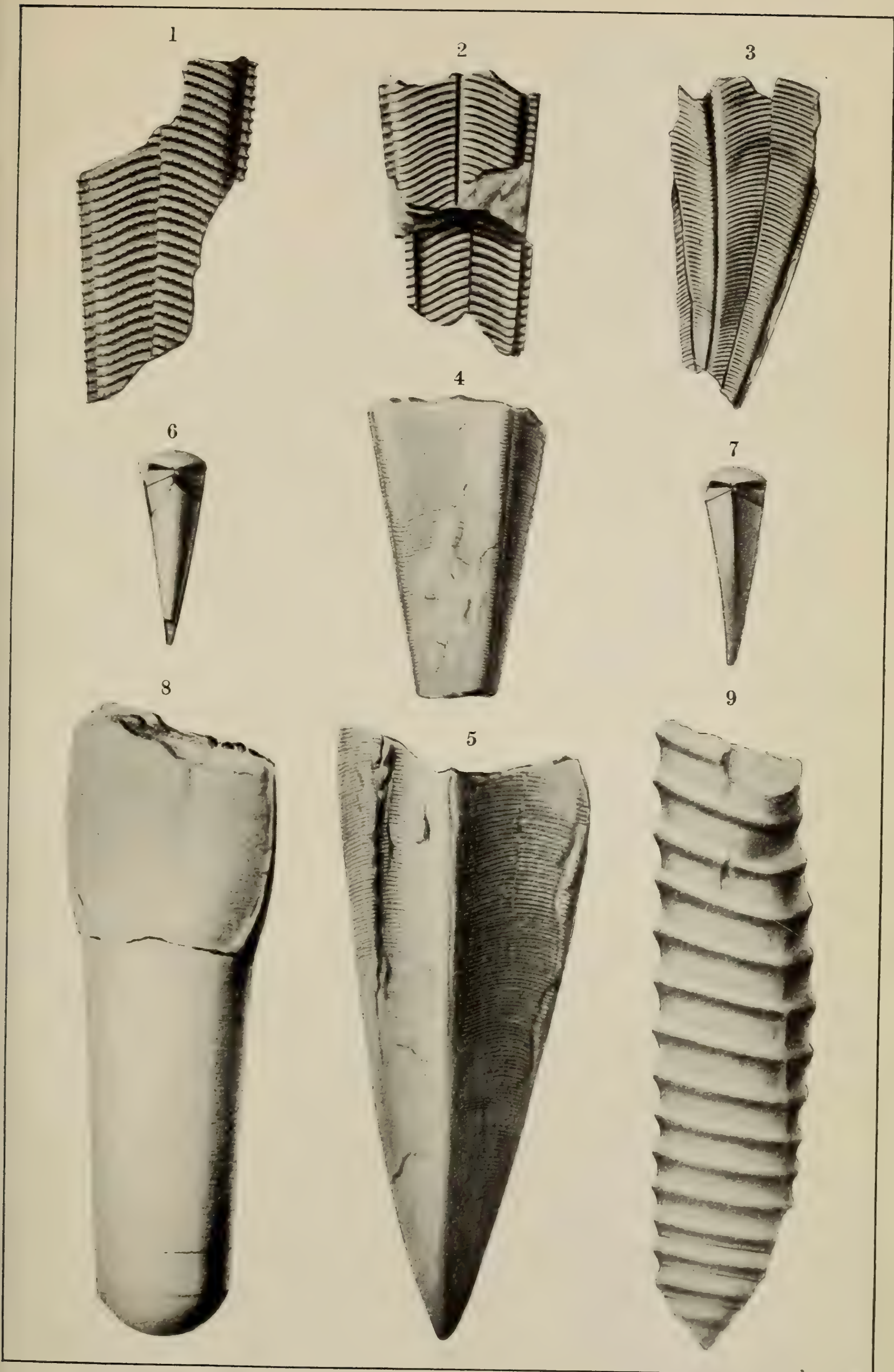
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Plate 12

163

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Tentaculites jaculus Clarke

Fig. 1 A cluster of tubes with characteristic irregularity of annulation. Natural size
Locality: Ponta Grossa, Brazil

Tentaculites crotalinus Salter

Fig. 2 A cluster of tubes. x 3
Locality: Ponta Grossa, Brazil

Tropidocyclus antarcticus Clarke

Fig. 3 Two accidently conjoined individuals
4 Dorsal view showing the character of the striae. x 1½
Locality: Pebble island, West Falkland

Plectonotus (Bucaniella) hapsideus Clarke

Fig. 5 A laterally compressed individual showing the dorsal seam
6, 7 Two other similarly compressed shells
Locality: Ponta Grossa, Brazil

Bellerophon quadrilobatus Salter?

Fig. 8 An internal cast of a trilobed shell which may pertain to this species
Locality: Pebble island, West Falkland

Diaphorostoma allardycei Clarke

Fig. 9, 10, 11 Three views of this species, indicating its form and style of ornament
Locality: Pebble island, West Falkland

Plectonotus (Bucaniella) dereimsi Knod

Fig. 12, 13, 14 Views of more or less complete examples of these shells
Locality: Ponta Grossa, Brazil

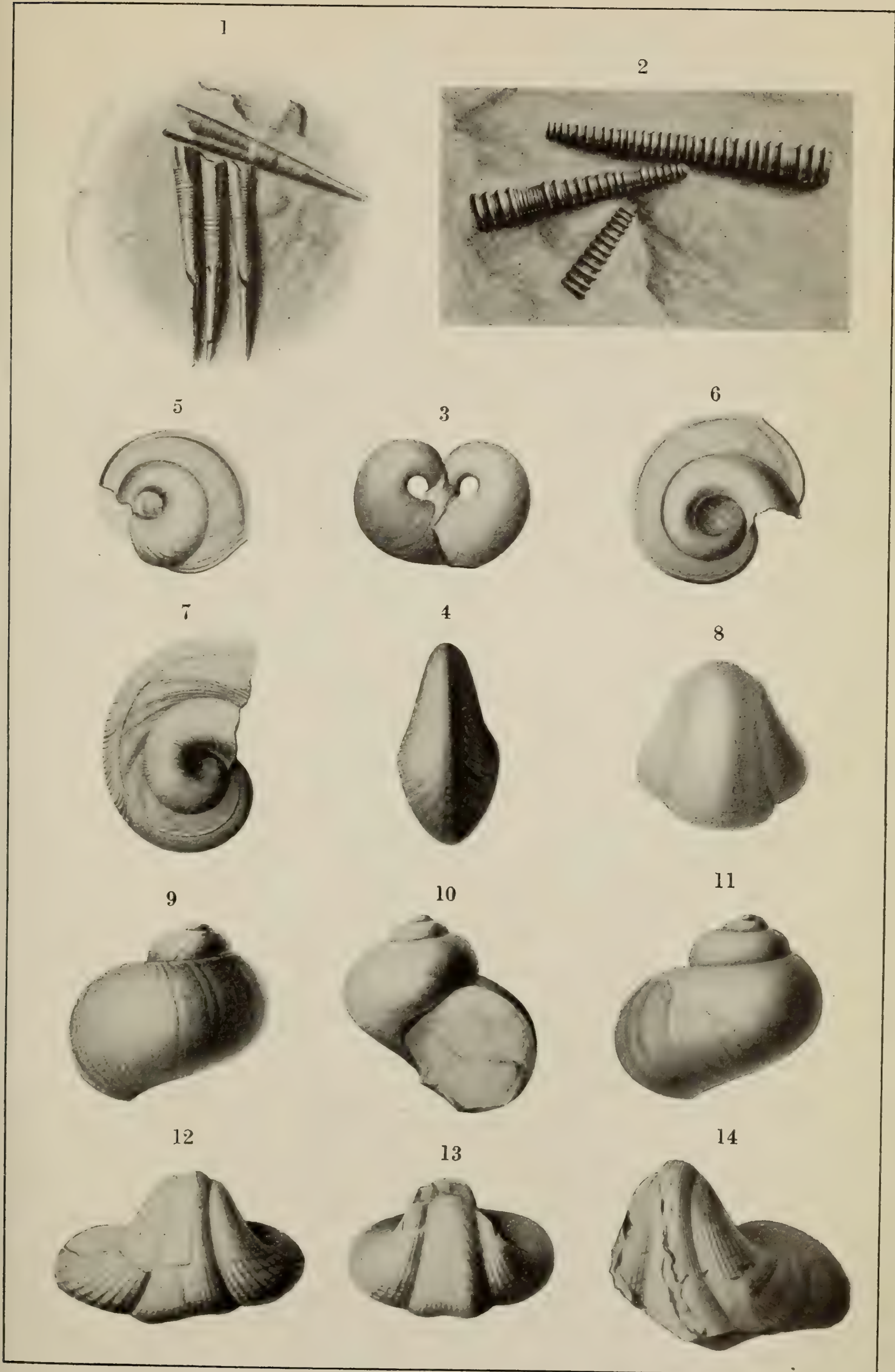
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Plate 13

165

Ptomatis moreirai Clarke

Fig. 1, 2 Exteriors of two examples
Locality: Ponta Grossa, Brazil

Nuculites reedi Clarke

Fig. 3, 4, 5 Sculpture casts showing the sinuous posterior slopes
Locality: Ponta Grossa, Brazil

Nuculites parai Clarke

Fig. 6, 7 Sculpture casts from the Upper Devonic black shale, near Ereré, State of Pará, Brazil

Nuculites sharpei Reed

Fig. 8 Sculpture casts of both valves
9, 10 Other examples of the species
Locality: Ponta Grossa, Brazil
11, 12 A large specimen of this type with rather heavy clavicles but with the sinuous posterior slopes
Locality: Pebble island, West Falkland

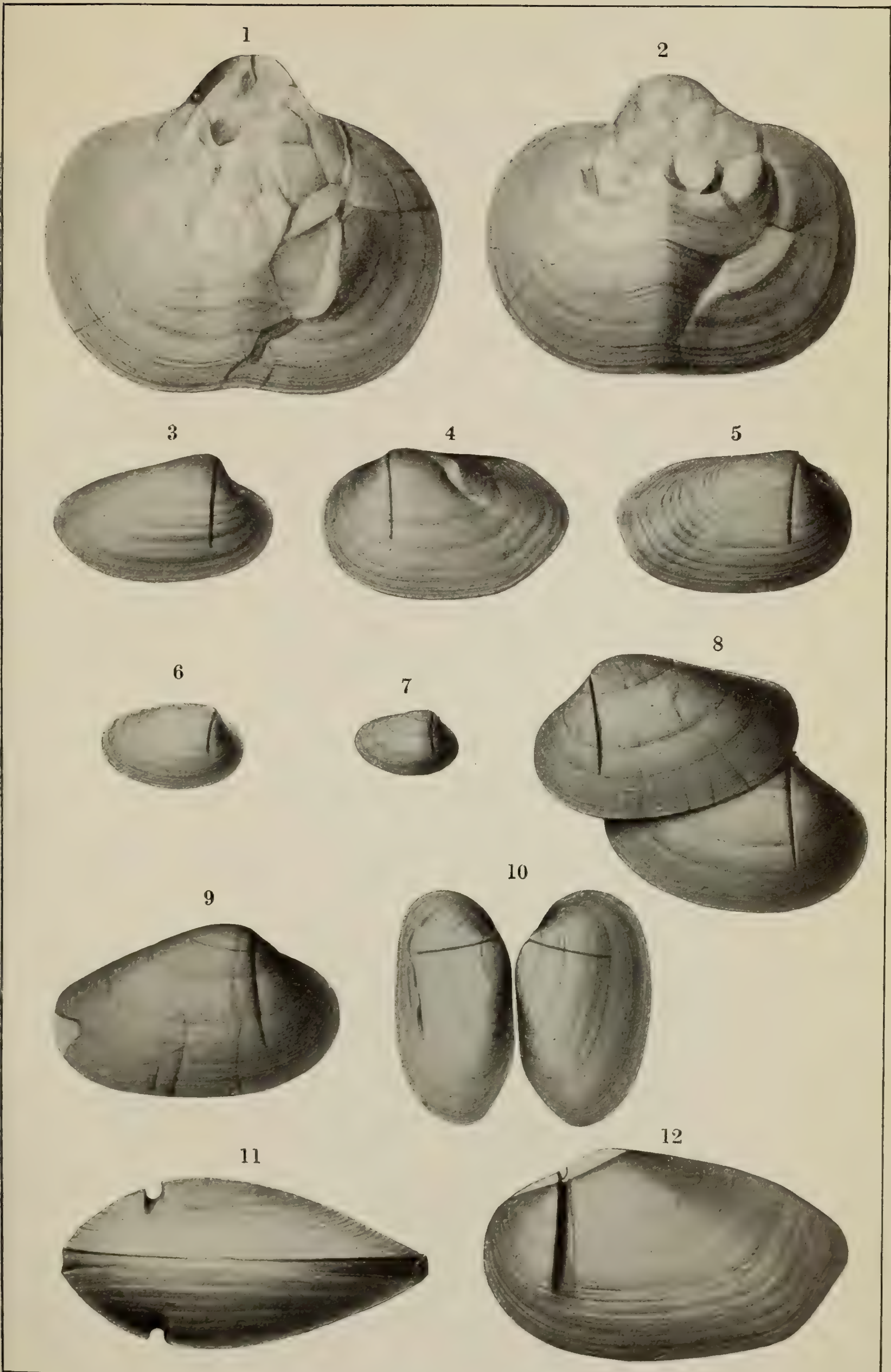
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Plate 14

Nuculana inornata (Sharpe)

Fig. 1, 2 Opposite sides of the same specimen
3 Another characteristic example
Locality: Ponta Grossa, Brazil

Palaeoneilo rhysa Clarke

Fig. 4, 5 Left and right valves
6 Enlargement of surface ornament of figure 4
Locality: Ponta Grossa, Brazil

Nuculites pacatus Reed

Fig. 7 Interior cast of conjoined valves with strong clavicular ridges
Locality: Jaguariahyva, São Paulo, Brazil
8 Sculpture cast of right valve
Locality: Ponta Grossa, Brazil

Palaeoneilo magnifica Clarke

(See plate 15)

Fig. 9 Internal cast of right valve, showing part of hinge. The borings are those of the sponge Clionolithus priscus (McCoy)
Locality: Ponta Grossa, Brazil

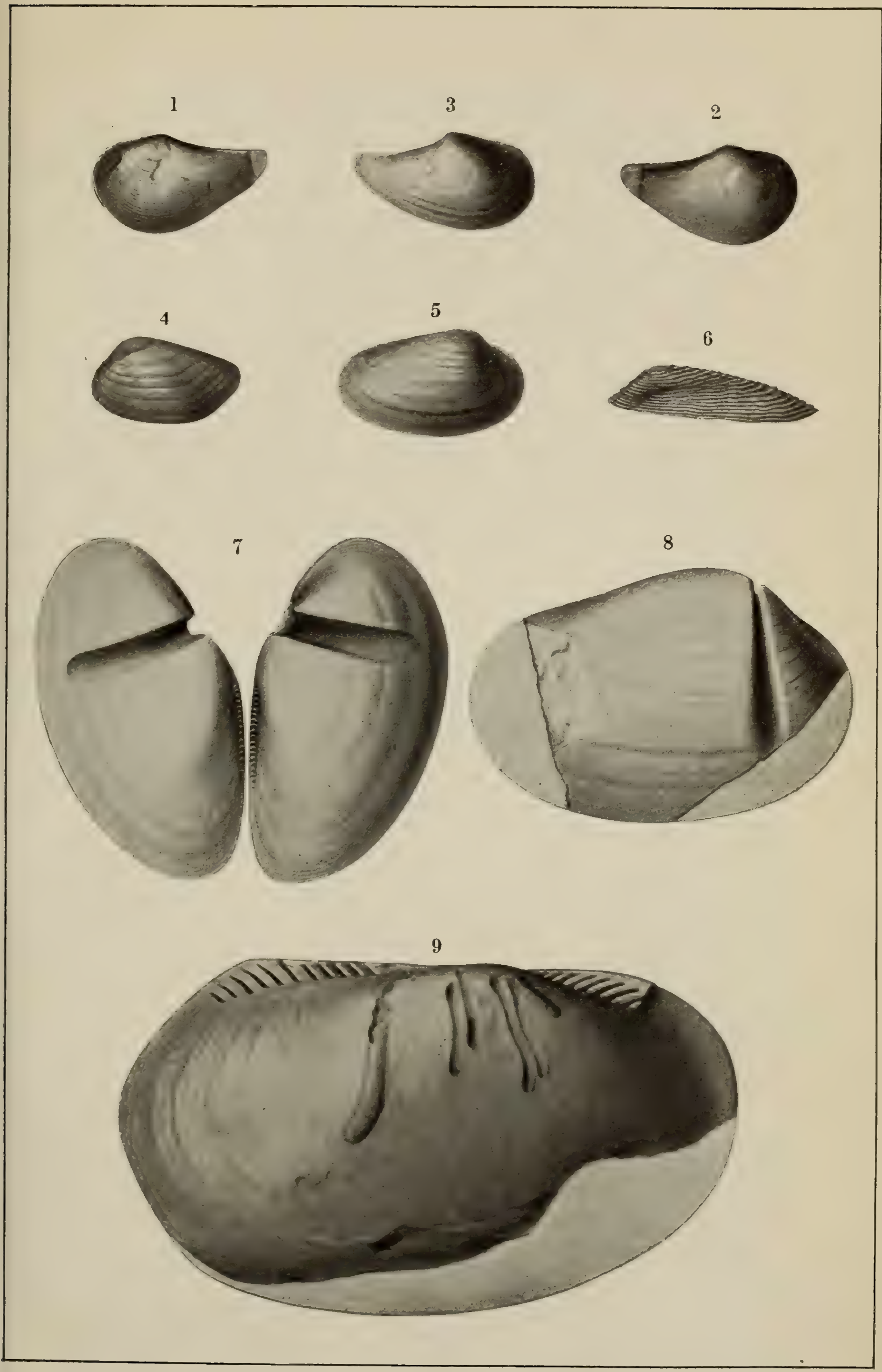

Plate 15

Palaeoneilo magnifica Clarke

(See plate 14)

Fig. 1 Exterior of left valve
2 Sculpture cast of conjoined valves
Locality: Ponta Grossa, Brazil

Palaeoneilo sculptilis Clarke

Fig. 3 A weathered right valve showing the radial ornament. From the Upper Devonic shale of Ereré, Pará, associated with S c h i z o b o l u s   t r u n c a t u s and N u c u l i t e s   p a r a i

Palaeoneilo sancticrucis Clarke

Fig. 4, 5 Right valves of this species
Locality: Ponta Grossa, Brazil

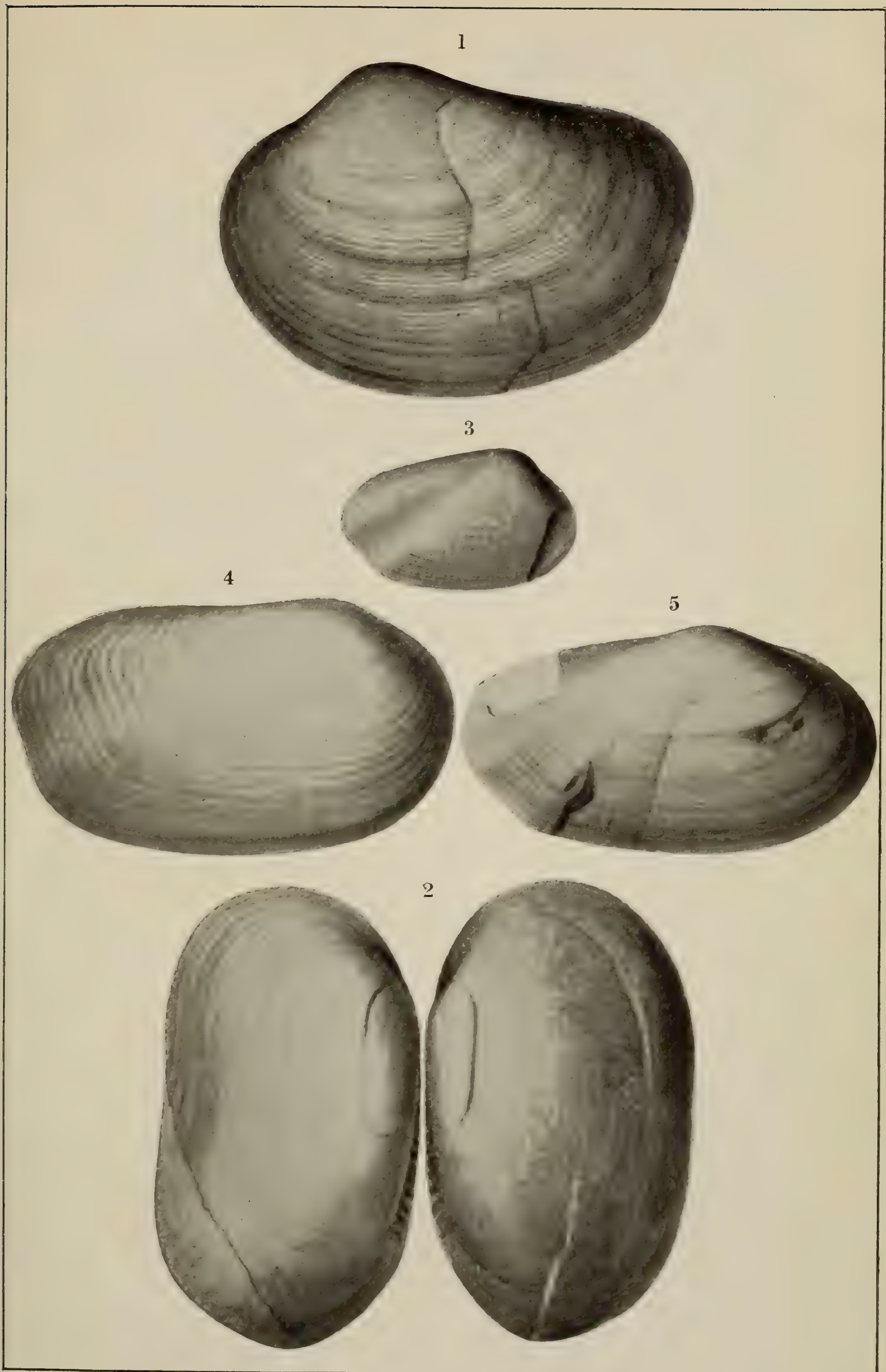
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Plate 16

Prothyris (Paraprothyris) knodi Clarke

Fig. 1, 2 Conjoined valves, showing the anterior byssal notch and posterior cardinal ridge

3, 4, 5, 6 Other valves showing in more detail the cardinal characters

7 Enlargement of posterior part of specimen figure 4

Locality: Ponta Grossa, Brazil

Cardiomorpha ? colossea Clarke

Fig. 8 Sculpture cast of a right valve of medium size

Locality: Ponta Grossa, Brazil

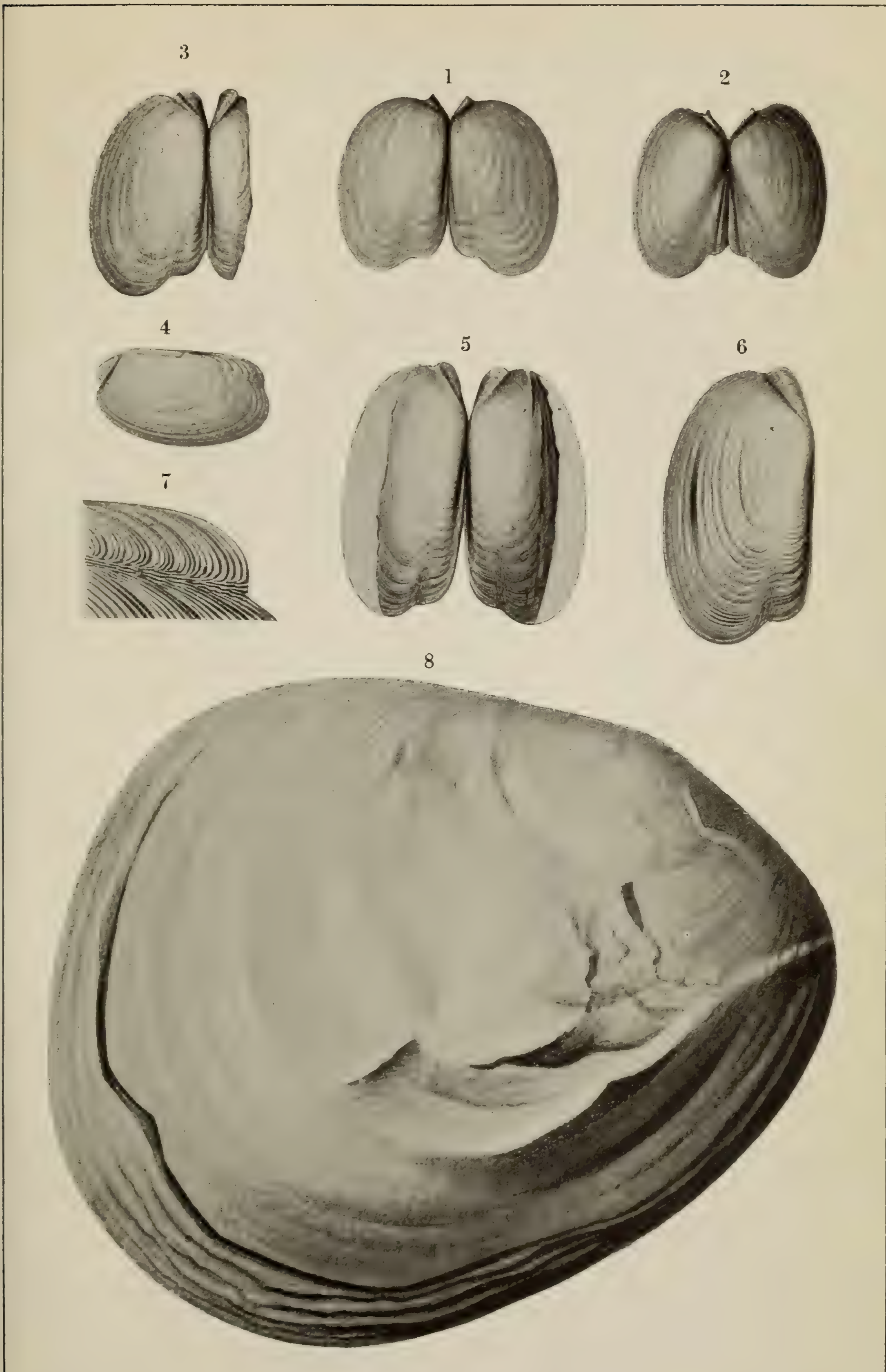
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Plate 17

Pleurodapis multicincta Clarke

Fig. 1, 2 Right and left valves

3 Sculpture casts of conjoined valves with suppression of some of the posterior ridges. The abscission of the umbones by pressure on the hinge-plates is noticeable here, as on the succeeding figures

4 The hinge, showing anterior muscle scars and a broadened platform behind. x 2

5, 6 Right valves, showing considerable divergence in the development of the ridges

Locality: Ponta Grossa, Brazil

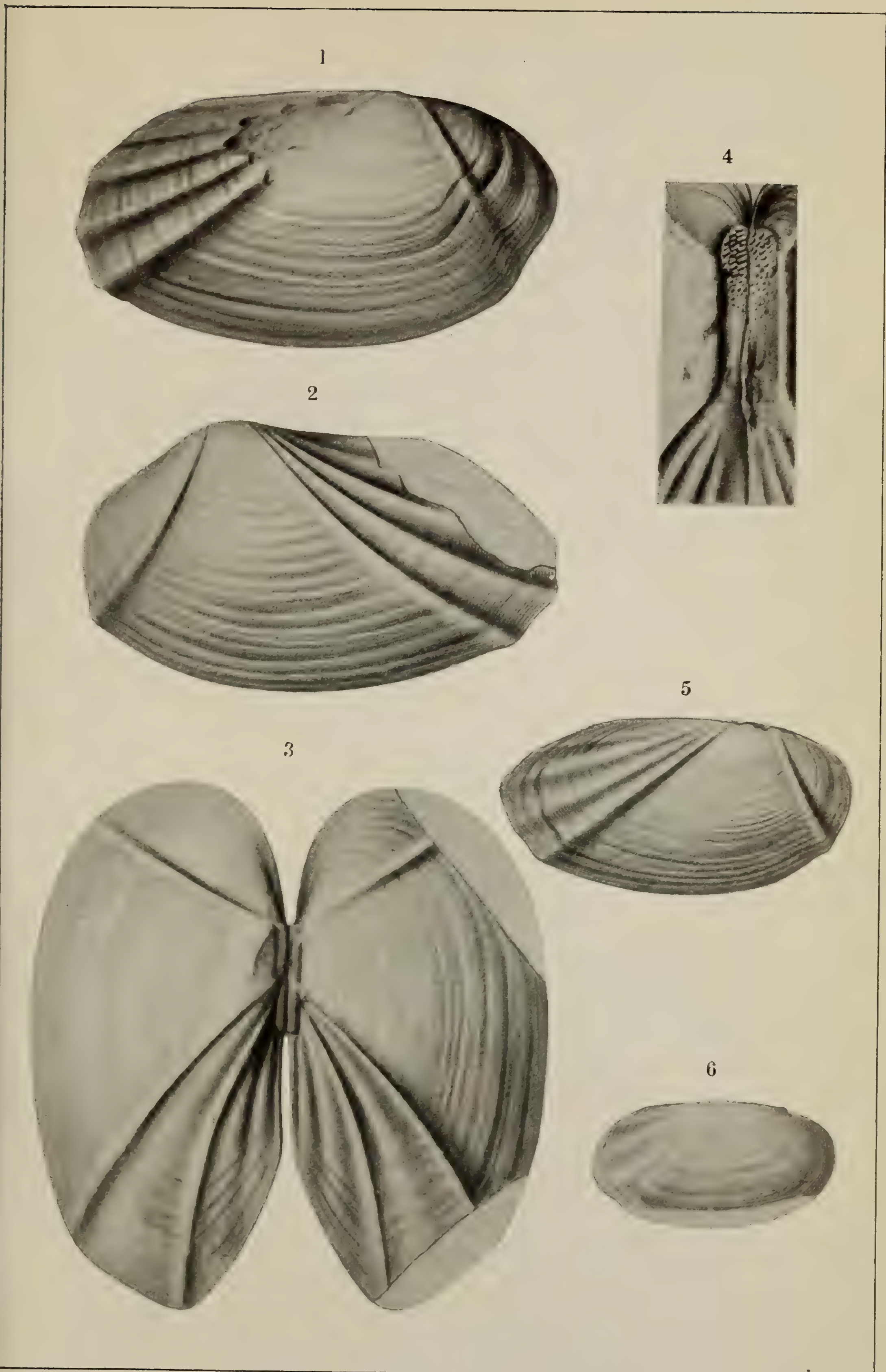
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Plate 18

Janeia bokkeveldensis Reed

Fig. 1 Conjoined valves showing the overlapping left
2 The two valves with overlapping right
3 A large left valve
4 Sculpture of posterior part of valve. x 3
Locality: Ponta Grossa, Brazil

Janeia braziliensis Clarke

Fig. 5 Right side of conjoined valves, showing the overlapping left
6 A small specimen
7 Large shell with valves slightly spread
8 Left view of conjoined valves
Locality: Tybagy, São Paulo, Brazil

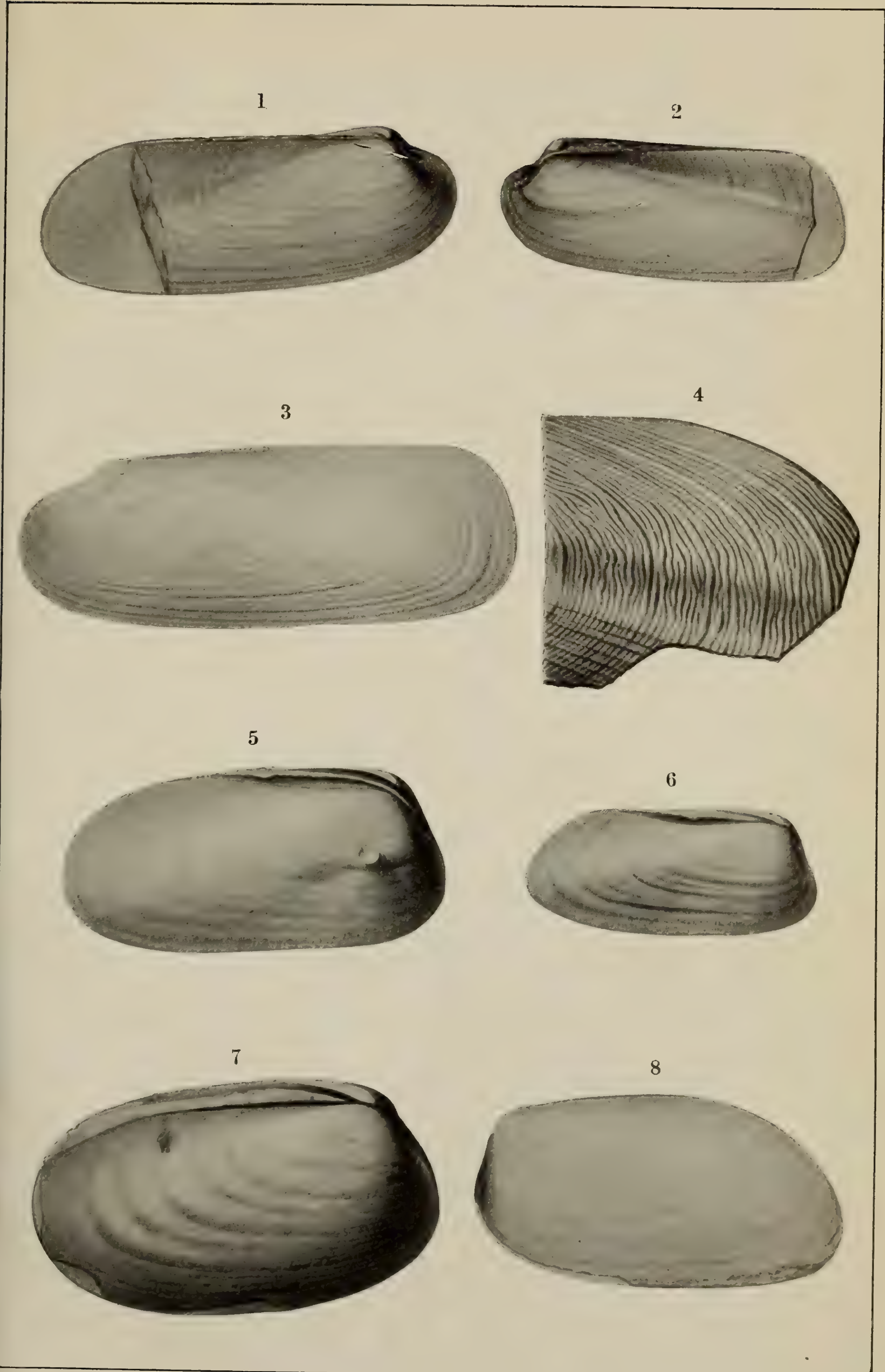
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Plate 19

Goniophora abbreviata Clarke

Fig. 1, 2 Sculpture casts of right valves
Locality: Jaguariahyva, São Paulo, Brazil

Palaeanatina erebus Clarke

Fig. 3, 4, 5 Conjoined expanded valves
Locality: Ponta Grossa, Brazil

Cypricardella? olivieria Clarke

Fig. 6 Conjoined valves, natural size
7 The left valve, x 3
Locality: Ponta Grossa, Brazil

Sphenotus lagoensis Clarke

Fig. 8 Expanded conjoined valves with the crescence ridge somewhat intensified by compression
9 A right valve
Locality: Lago, state of São Paulo, Brazil

Leptodomus capricornus Clarke

Fig. 10 A right valve
11 A left valve
12 Enlargement of posterior slope
Locality: Ponta Grossa, Brazil

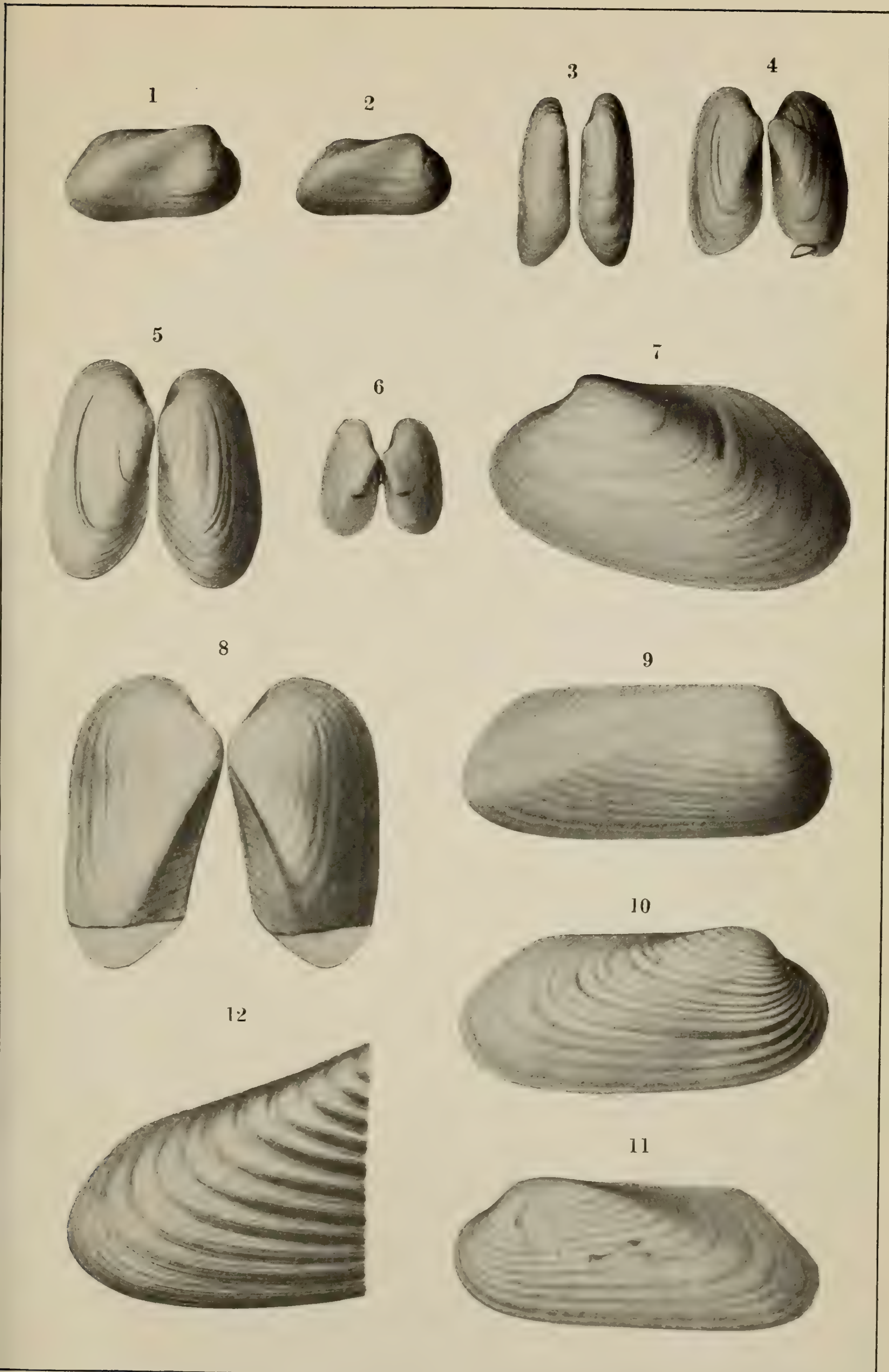
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Plate 20

Modiomorpha austronotica Clarke

Fig. 1, 2 Sculpture casts of right and left valves
3 A right valve
4 Expanded valves in juxtaposition
Locality: Ponta Grossa, Brazil

Modiomorpha ? scaphula Clarke

Fig. 5, 6 Right and left sculpture valves
Localities: Ponta Grossa and Tybagy, Brazil

Phthonia ? epops Clarke

Fig. 7 Right valve showing surface characters
8 Enlargement of surface on posterior slope
Locality: Jaguariahyva, Brazil

Pholadella cf radiata Hall

Fig. 9 Fragment of a large specimen provisionally referred to this species
Locality: Tybagy, Brazil

Leptodomus ulrichi Clarke

Fig. 10, 11 Left valves of this species
Locality: Ponta Grossa, Brazil

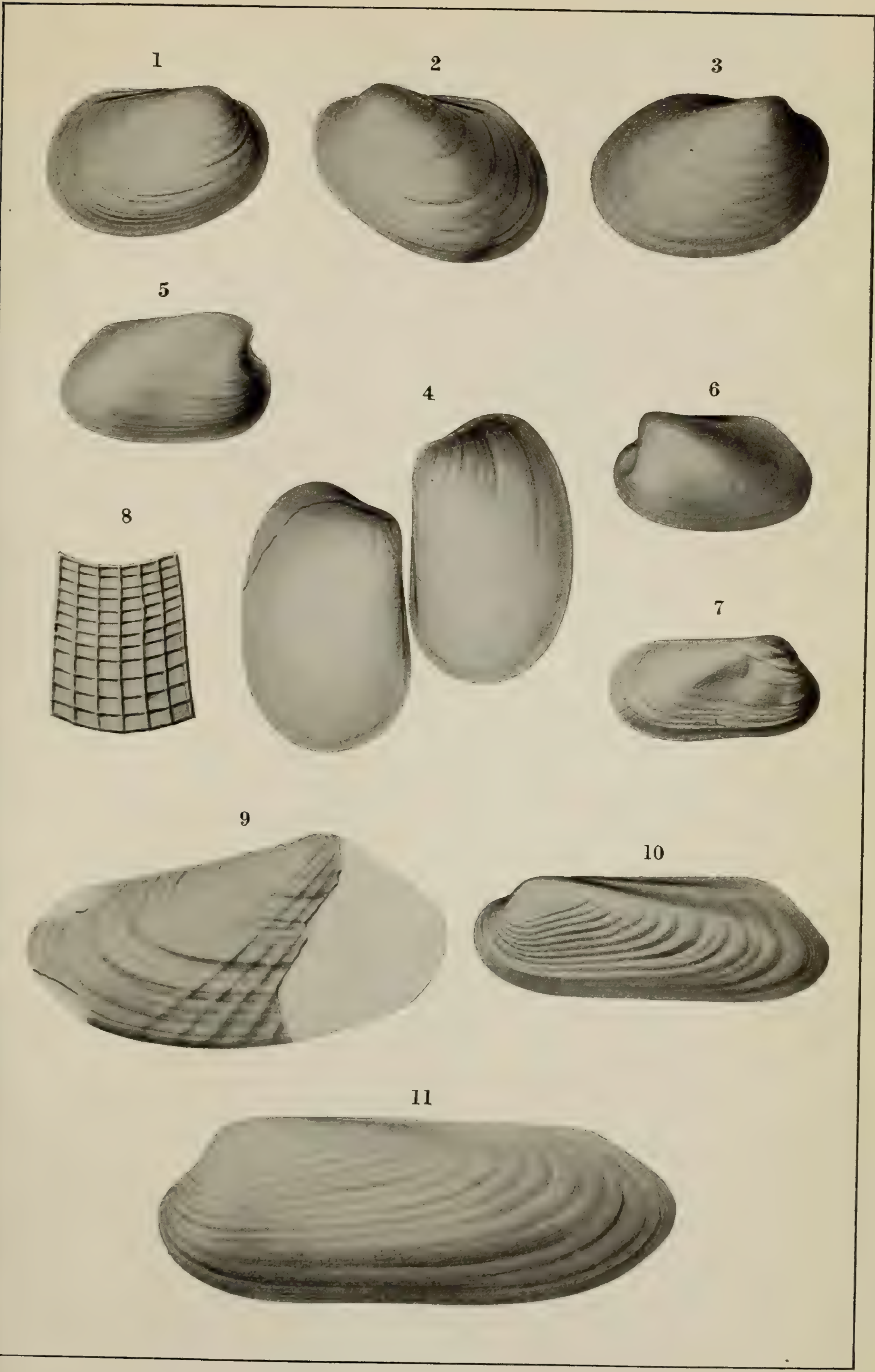
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Plate 21

Derbyina smithi (Derby)

Fig. 1, 2 Copies of Derby's figures of the brachial apparatus
3 Ventral side of an internal cast. x 2
4, 5, 6 Ventral profile and dorsal views of an internal cast. x 2
Locality: Ponta Grossa, Brazil

Paranaia margarida (Derby)

Fig. 7, 8 Derby's figures of the brachial apparatus
Locality: Sant'Ana de Chapada, Mato Grosso, Brazil

Cryptonella ? baini (Sharpe)

Fig. 9 Cast of ventral valve
10, 11 Dorsal views of internal casts
12 Dorsal valve with hinge plate
13 Enlargement of the surface of an inside cast, showing the filling of the shell punctures
Locality: Tybagy, São Paulo, Brazil

Rensselaeria falklandica Clarke

Fig. 14 Internal cast of ventral valve
15 Dorsal view of an internal cast
Locality: Port Howard, East Falkland

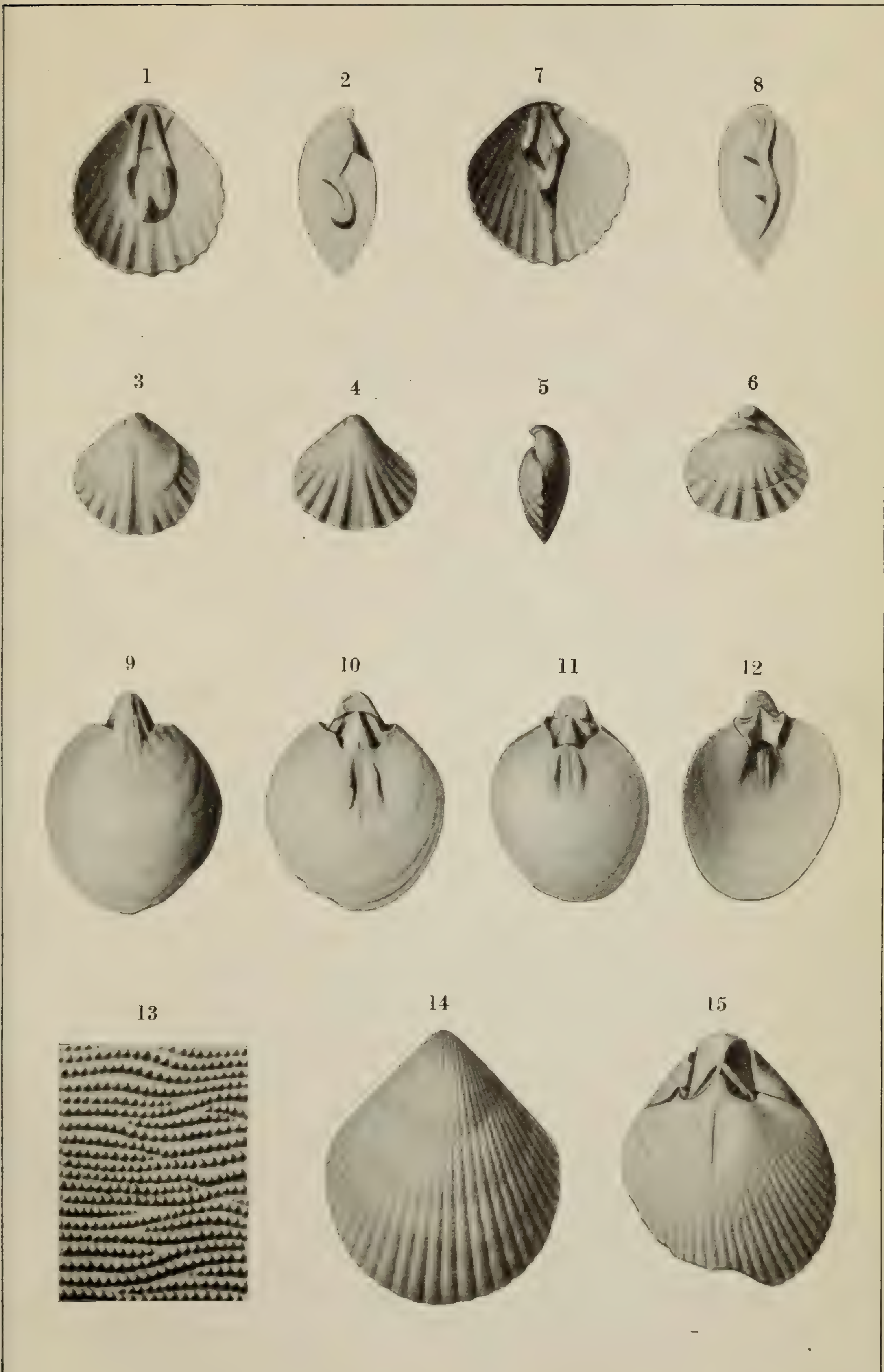
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Plate 22

Spirifer antarcticus Morris and Sharpe

Fig. 1 Ventral cardinal view of a shell without deltidium, but with apical callus

2 Similar view of an old shell with deltidium

Locality: Port Louis, East Falkland

3 Enlargement of surface

Locality: Jaguariahyva, Brazil

4 Enlargement of surface

6, 7 Dorsal valves

8 Exterior of a large individual

9 Internal cast of the same valve

Locality: Port Louis, East Falkland

Spirifer hawkinsi Morris and Sharpe

Fig. 10 Dorsal valve

11 Dorsal side of an internal cast

Locality: Port Louis, East Falkland

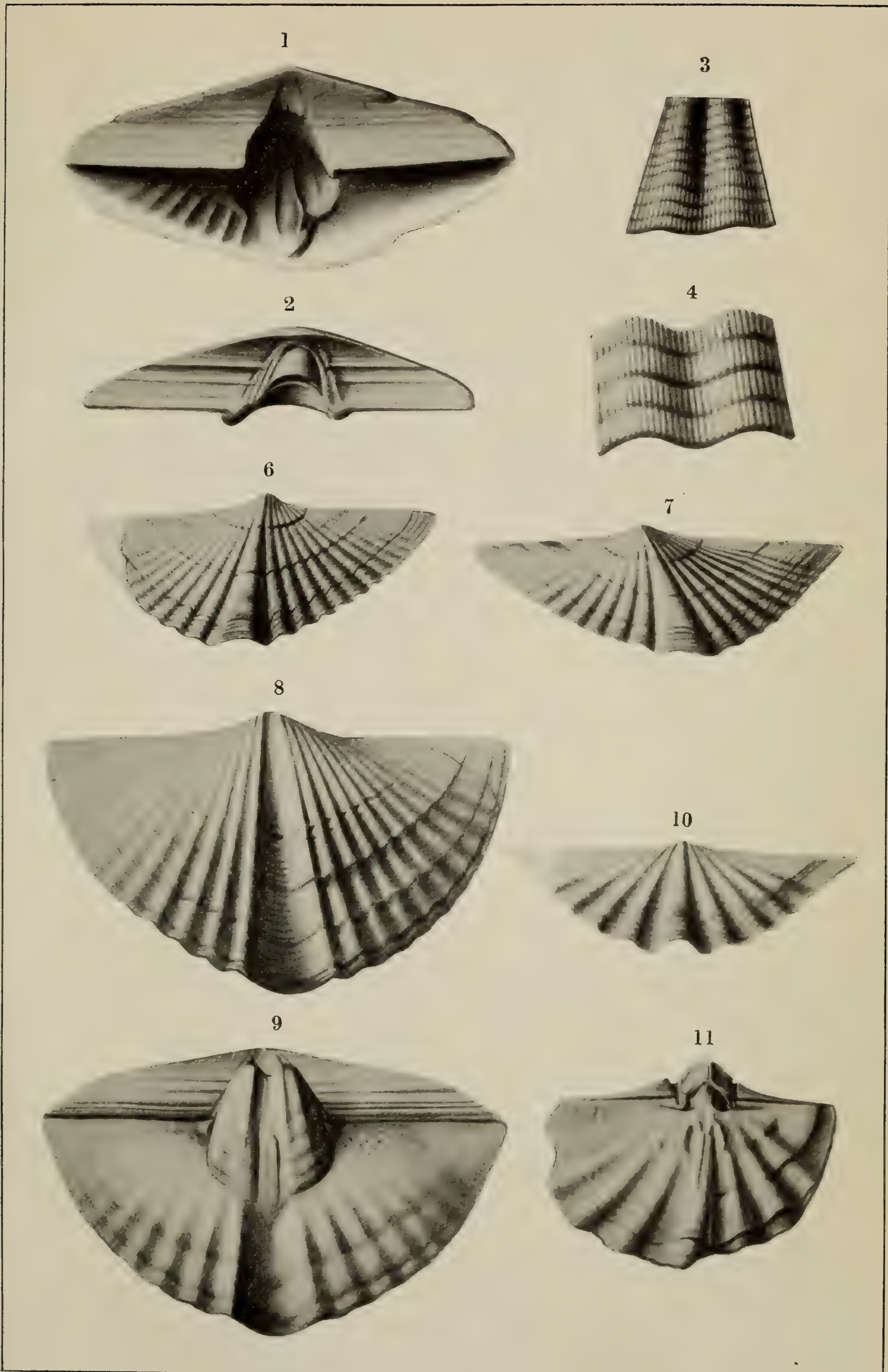
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Plate 23

Spirifer kayserianus Clarke

Fig. 1 A well-preserved dorsal valve, with the characteristic mature sculpture

2 Sculpture cast of the ventral valve

3, 4 Dorsal valves of adult shells

Locality: Ponta Grossa, Brazil

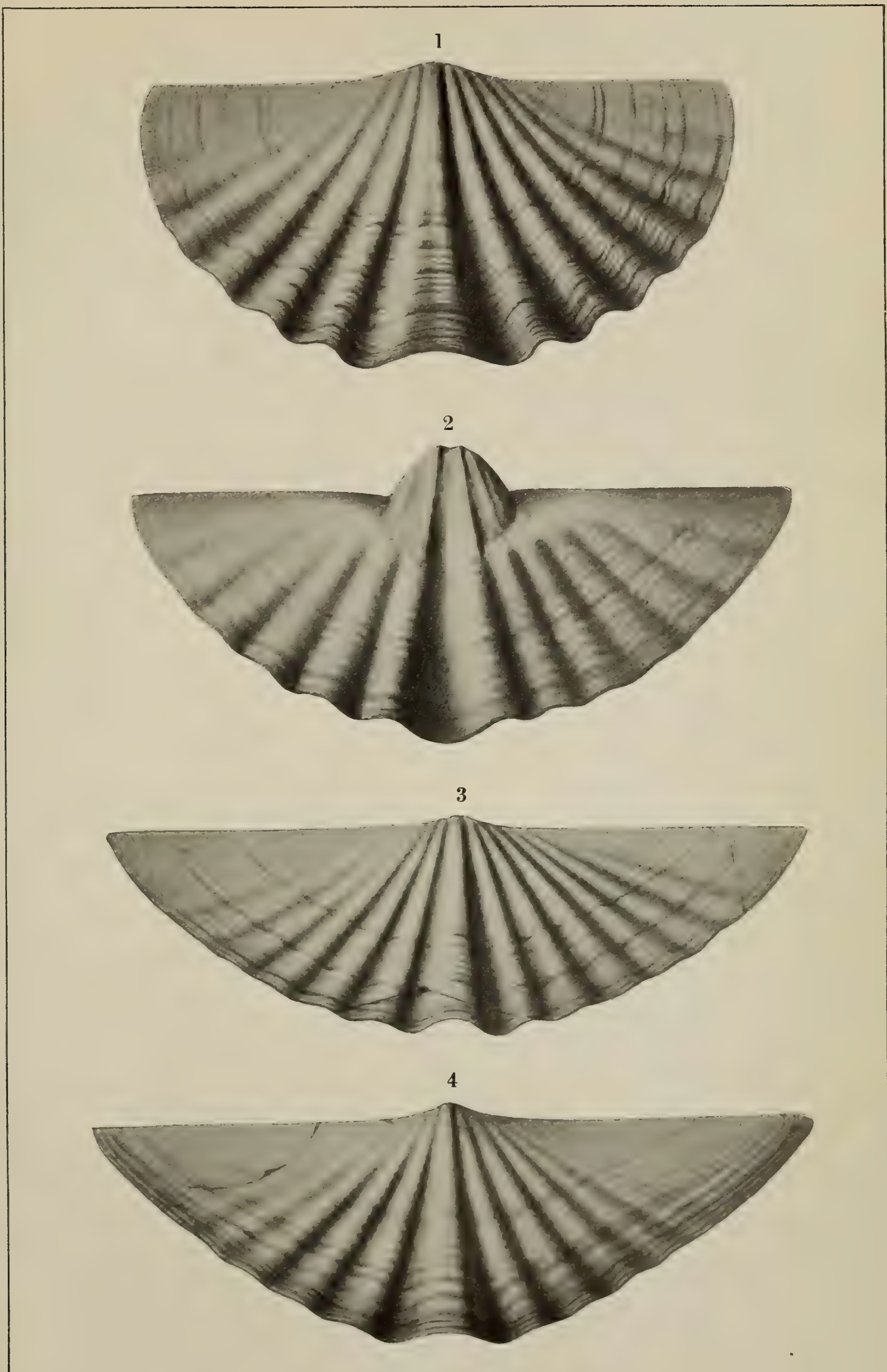
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Plate 24

Spirifer iheringi Kayser

(See plate 25)

Fig. 1, 2 Dorsal aspects of internal casts of young shells
3 Front view of conjoined valves of a mature individual
4 Enlargement of surface in a mature valve
5 A mature dorsal valve
6 Dorsal view of a characteristic internal cast
7, 8 The cardinal process in different stages of development
Locality: Tybagy, state of São Paulo, Brazil

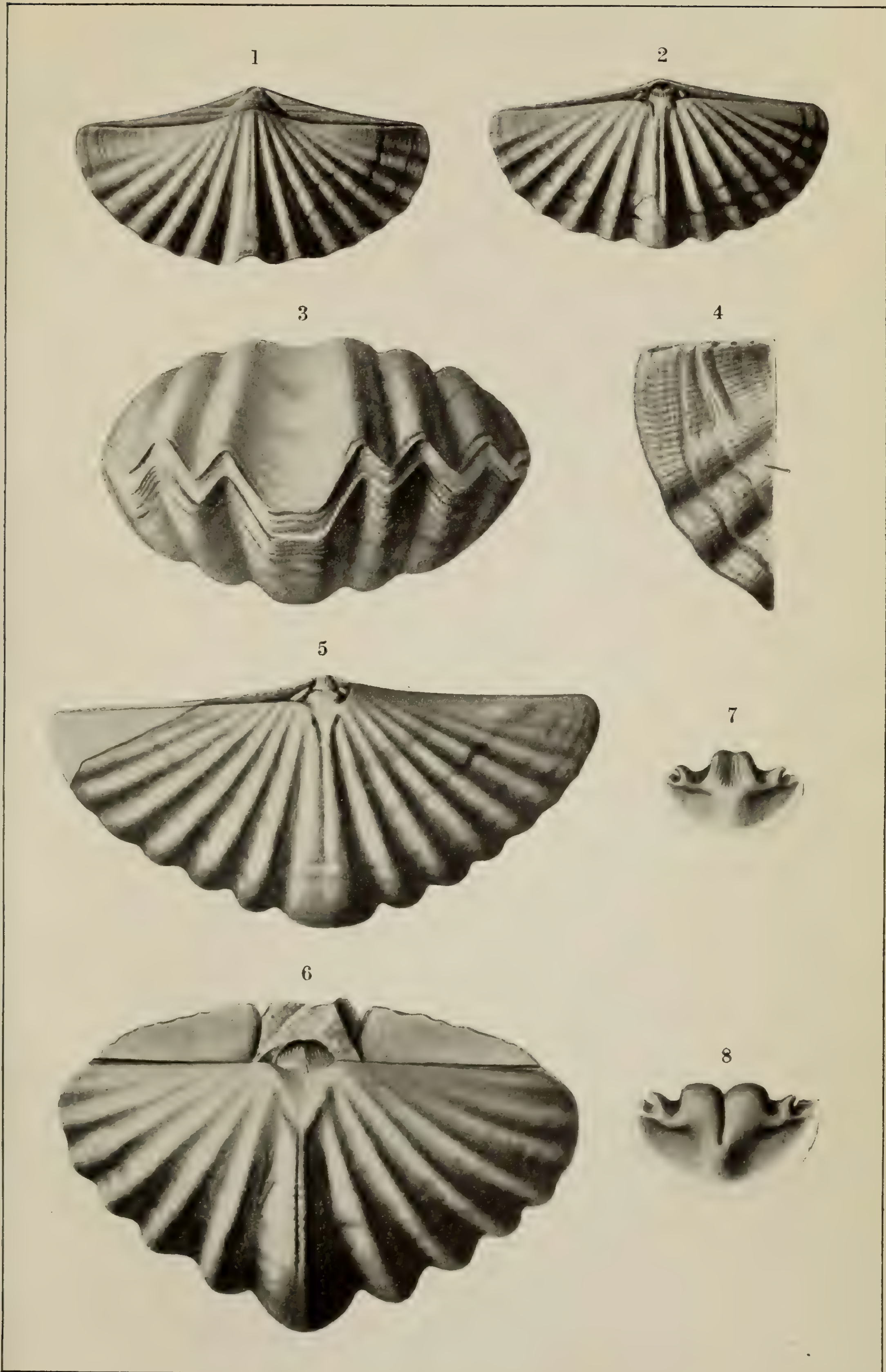
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Plate 25

Spirifer lauro-sodreanus Katzer

Fig. 1, 2 Two views of the type specimen
Locality: Maecurú sandstone, Rio Maecurú, Pará

Spirifer iheringi Kayser

(See plate 24)

Fig. 3 Ventral view of large internal cast
4 View of large ventral cast
Locality: Tybagy, Brazil

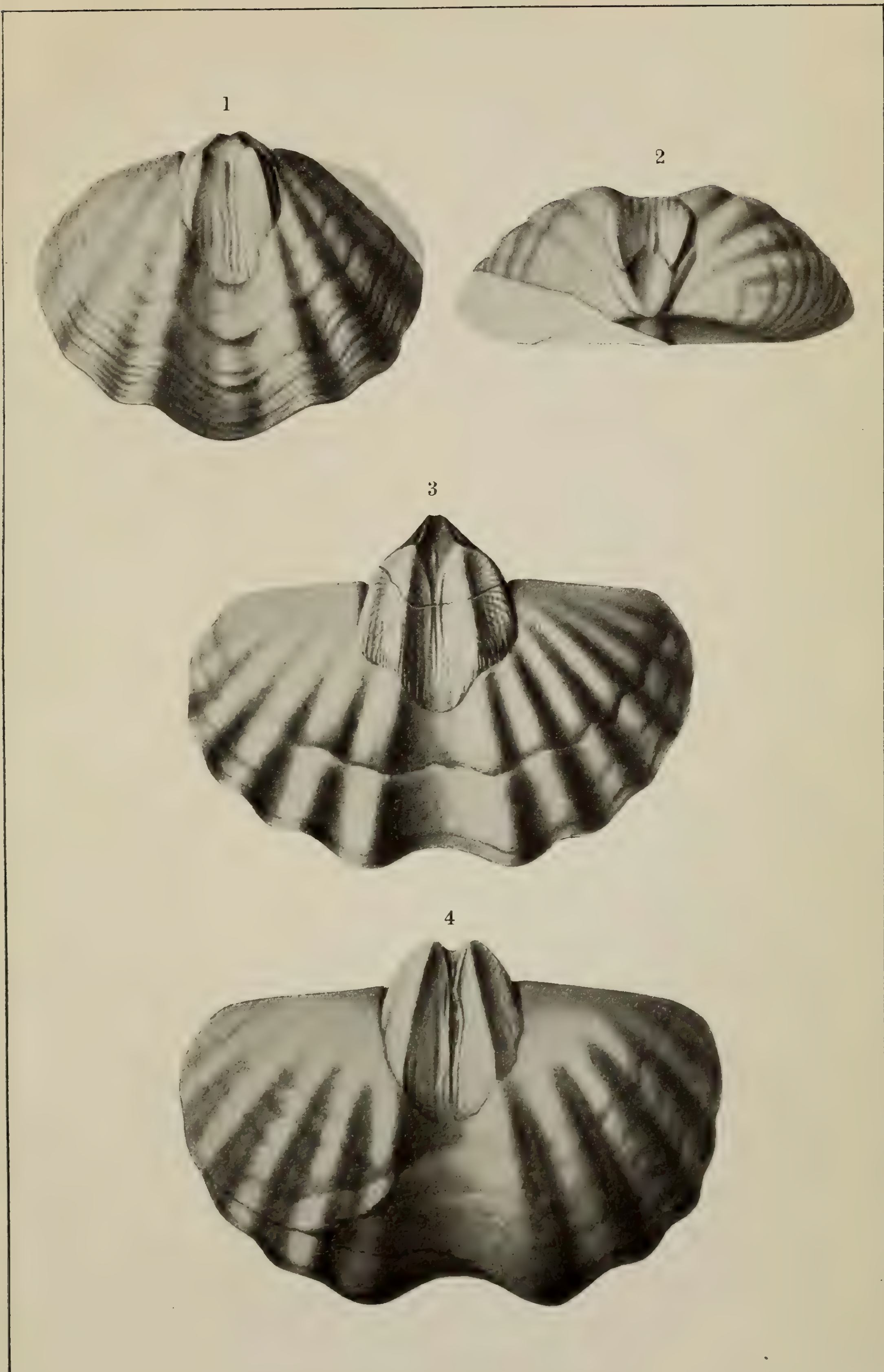
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Plate 26

Spirifer katzeri Clarke

Fig 1, 2 View of a dorsal valve, showing the elevation of the fold and the number of ribs
Locality: Maecurú sandstone, Rio Maecurú, Pará

Spirifer contrarius Clarke

Fig. 3, 4 Casts of dorsal valves showing sharp, distinct ribs and broadly concave interspaces
Locality: Ponta Grossa, Brazil

Spirifer parana Clarke

Fig. 5 A dorsal valve with few broadly rounded ribs
6 A crushed specimen with similar characters
Locality: Ponta Grossa, Brazil

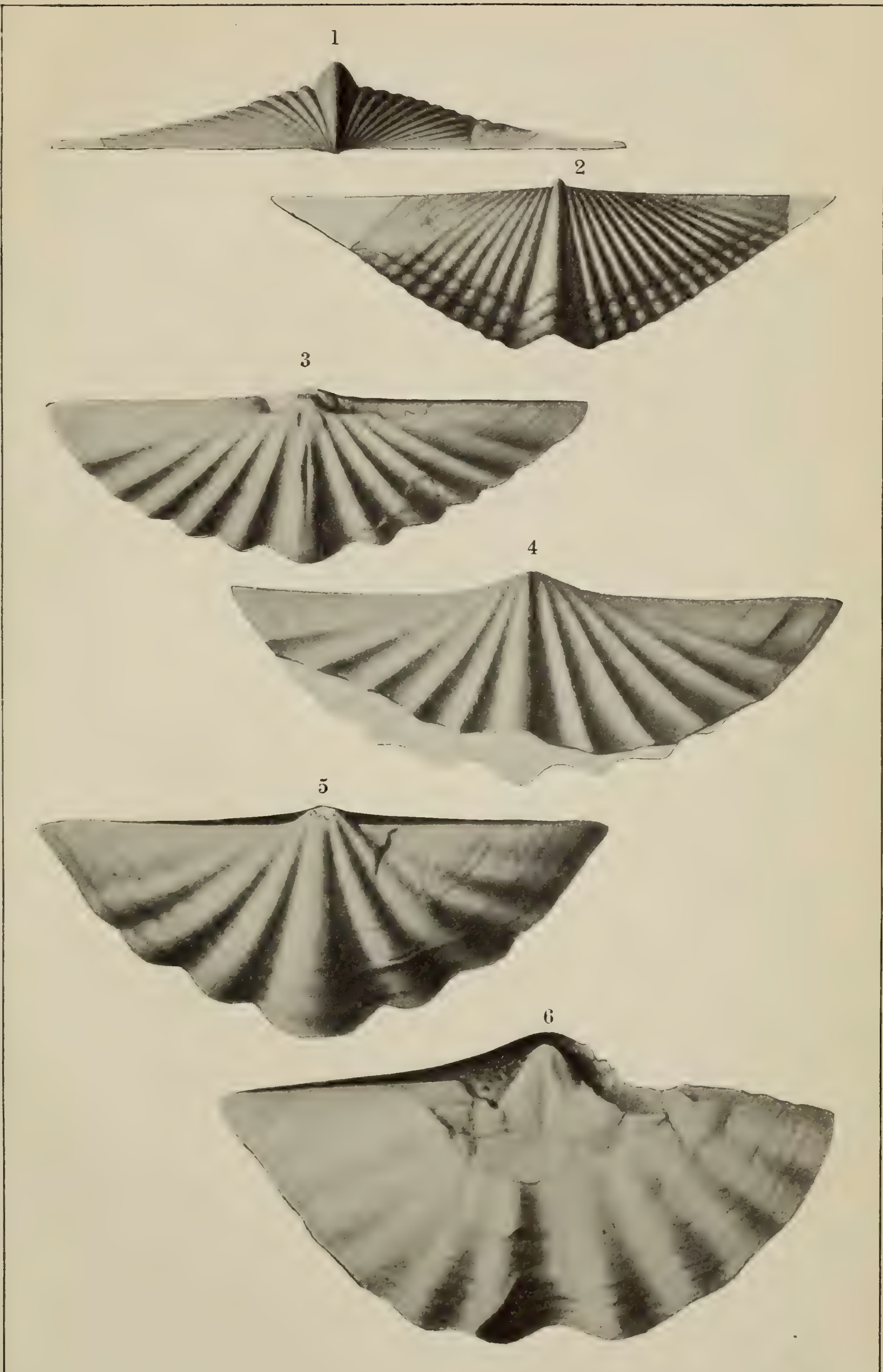
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Plate 27

Derbyina whitiorum Clarke

Fig. 1, 2 Exterior and internal cast of ventral and dorsal valves
3 Enlargement of ventral hinge
4 A dorsal valve
Locality: Ponta Grossa, Brazil

Leptocoelia flabellites (Conrad)

Fig. 5 Exterior of an average adult specimen
6 A dorsal valve
7 Internal cast of large ventral valve
Locality: Ponta Grossa, Brazil
8 Internal cast of dorsal valve
Locality: Jaguariahyva, Brazil
9 Dorsal cast
Locality: Cold Bokkeveld, Cape Colony

Coelospira ? colona Clarke

Fig. 10, 11 Ventral valves. x 2
12, 13 Ventral and dorsal views. x 2
Locality: Ponta Grossa, Brazil

Leptostrophia ?? mesembria Clarke

Fig. 14 Exterior of ventral with internal cast of dorsal valve
15 Sculpture cast showing dorsal aspect
Locality: Fox bay, West Falkland
16 Enlargement of hinge structure showing incipient denticles or spinules on cardinal line
17 Internal cast of ventral valve
Locality: Ponta Grossa, Brazil
18 Internal ventral cast
Locality: Jaguariahyva, Brazil

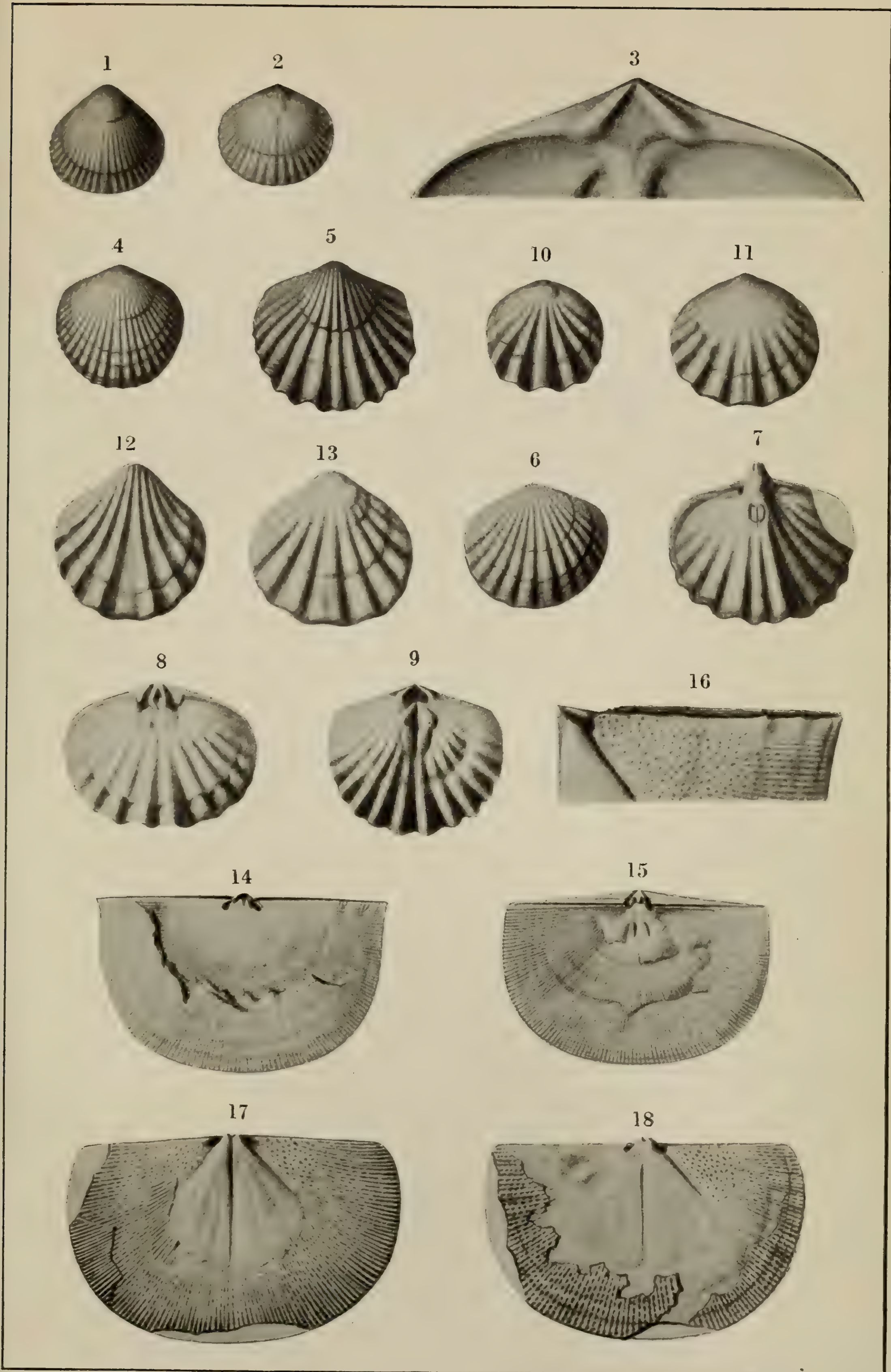
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Plate 28

Leptostrophia concinna (Morris & Sharpe)

Fig. 1 Internal cast of ventral valve
2 Interior of dorsal valve
3 Internal cast of ventral valve
Localities: Port Howard, West Falkland, and Port Louis, East Falkland

Schuchertella agassizi (Hartt & Rathbun)

Fig. 4 Two characteristic examples showing dorsal aspect only
5 Interior of ventral valve
6 A large and rather short hinged example
7 Internal cast of ventral valve
8 Interior of dorsal valve
Locality: Ponta Grossa, Brazil

Schuchertella sulivani (Morris & Sharpe)

Fig. 9 Internal cast of a ventral valve
Locality: Fox bay, West Falkland
10 Internal cast of dorsal valve
11 Interior of dorsal valve
12 Exterior of ventral valve
13 Dorsal aspect of conjoined valves
Locality: Ponta Grossa, Brazil

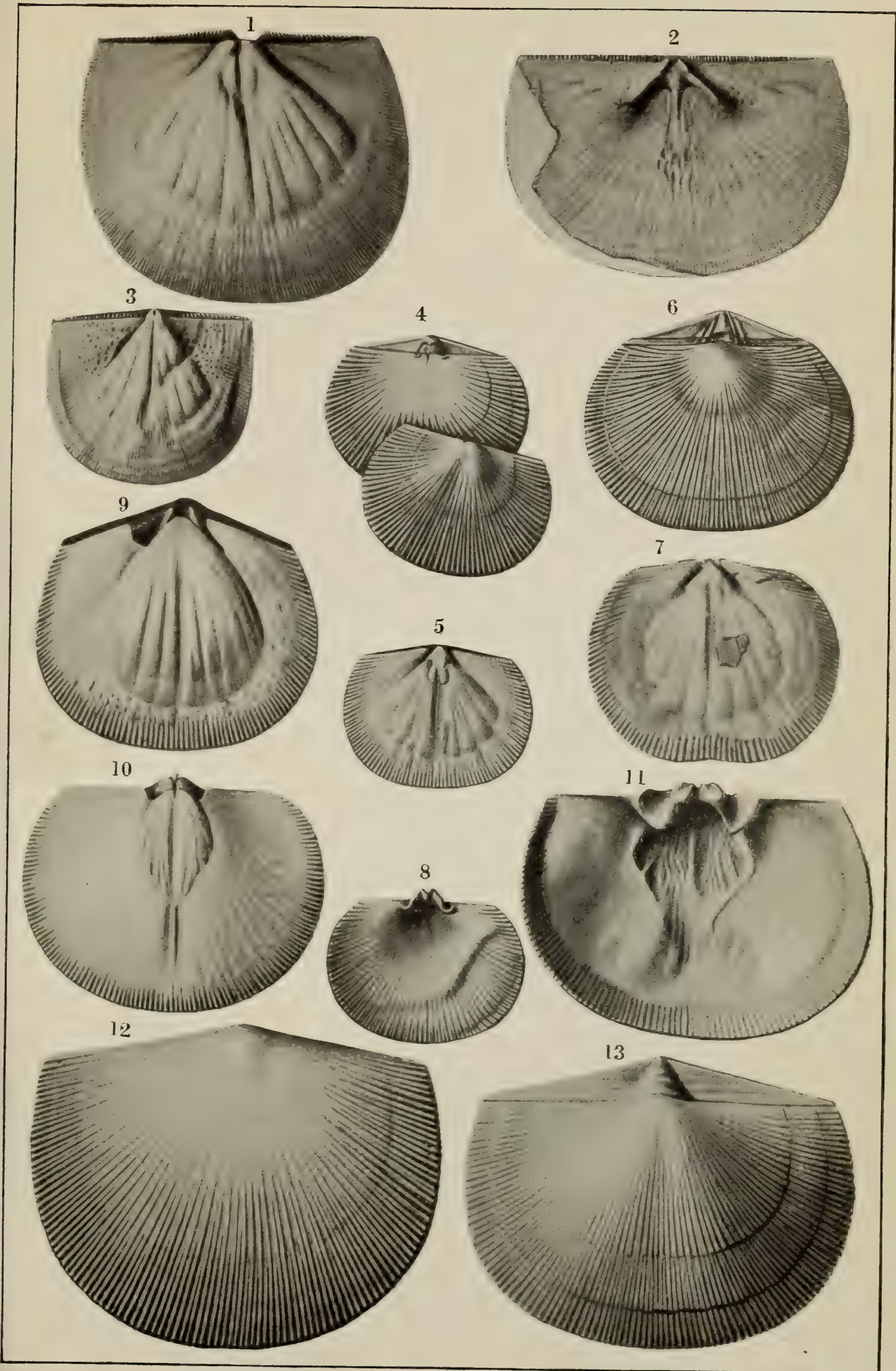
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Plate 29

Chonetes falklandicus Morris & Sharpe

Fig. 1–8 A series of views of this species showing its somewhat variable characters. Figures 1, 2, 3 are from Port Louis, East Falkland; figures 5, 7 from Ponta Grossa; figure 6 is the variety rugosa from Ponta Grossa; figures 4, 8 from Jaguariahyva

Chonetes skottsbergi Clarke

Fig. 9 Dorsal aspect of internal cast
10, 11 Internal casts of ventral valve
12 Interior of dorsal valve
Locality: Port Salvador, West Falkland

Schuchertella sancticrucis Clarke

Fig. 13, 14 Internal casts of dorsal and ventral valves
Locality: Santa Cruz, state of São Paulo, Brazil

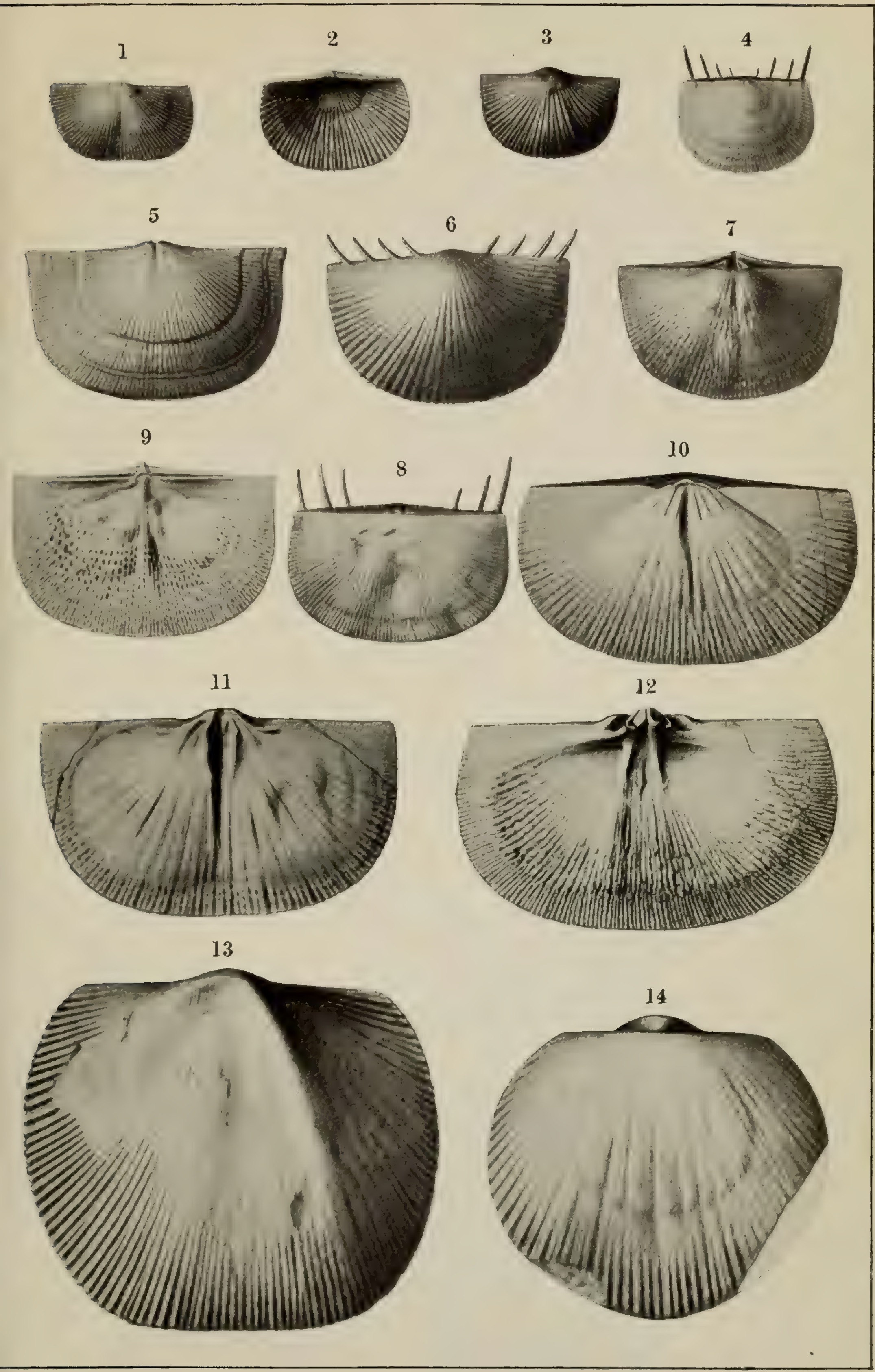
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Plate 30

Chonetes hallei Clarke

Fig. 1 Internal cast of conjoined valves
Locality: Spring Point, Falkland islands

Schizobolus truncatus Hall

Fig. 2, 3 Brachial and pedicle valves. x 3
Locality: Upper Devonic black shale of Ereré, Pará

Orbiculoidea baini (Sharpe)

Fig. 4, 5 Pedicle valves, exterior and interior surfaces
6, 7 Pedicle and brachial valves. x 2
8 Enlargement of surface of pedicle valve
Locality: Ponta Grossa, Brazil

Orbiculoidea bodenbenderi Clarke

Fig. 9, 10 Brachial valves
11 Pedicle valve
12 Enlargement of surface of pedicle valve
Locality: Ponta Grossa, Brazil

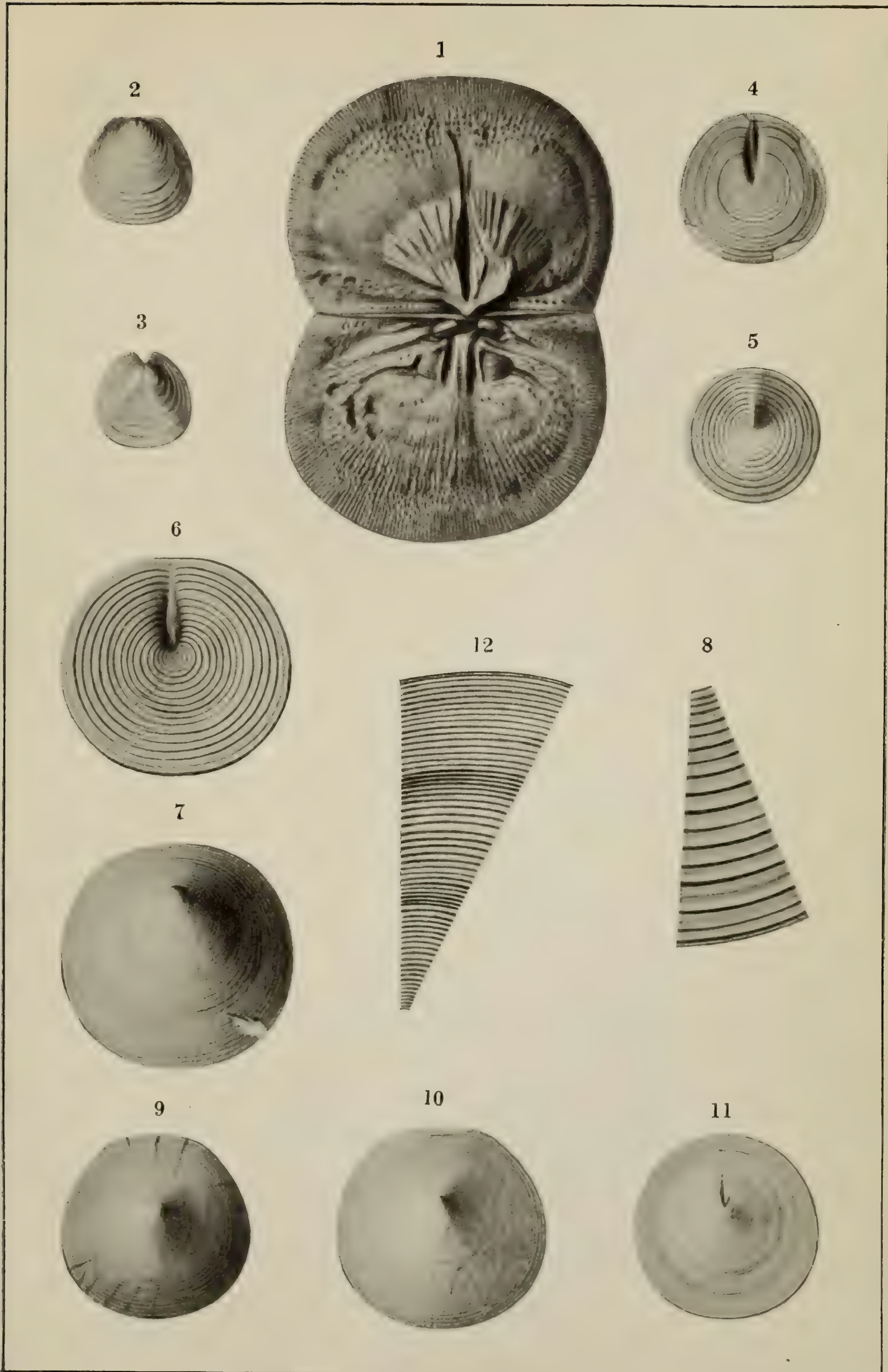
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Plate 31

Orbiculoidea collis Clarke

Fig. 1 Exterior of pedicle valve
2, 3 A brachial valve and its profile
Locality: Ponta Grossa, Brazil

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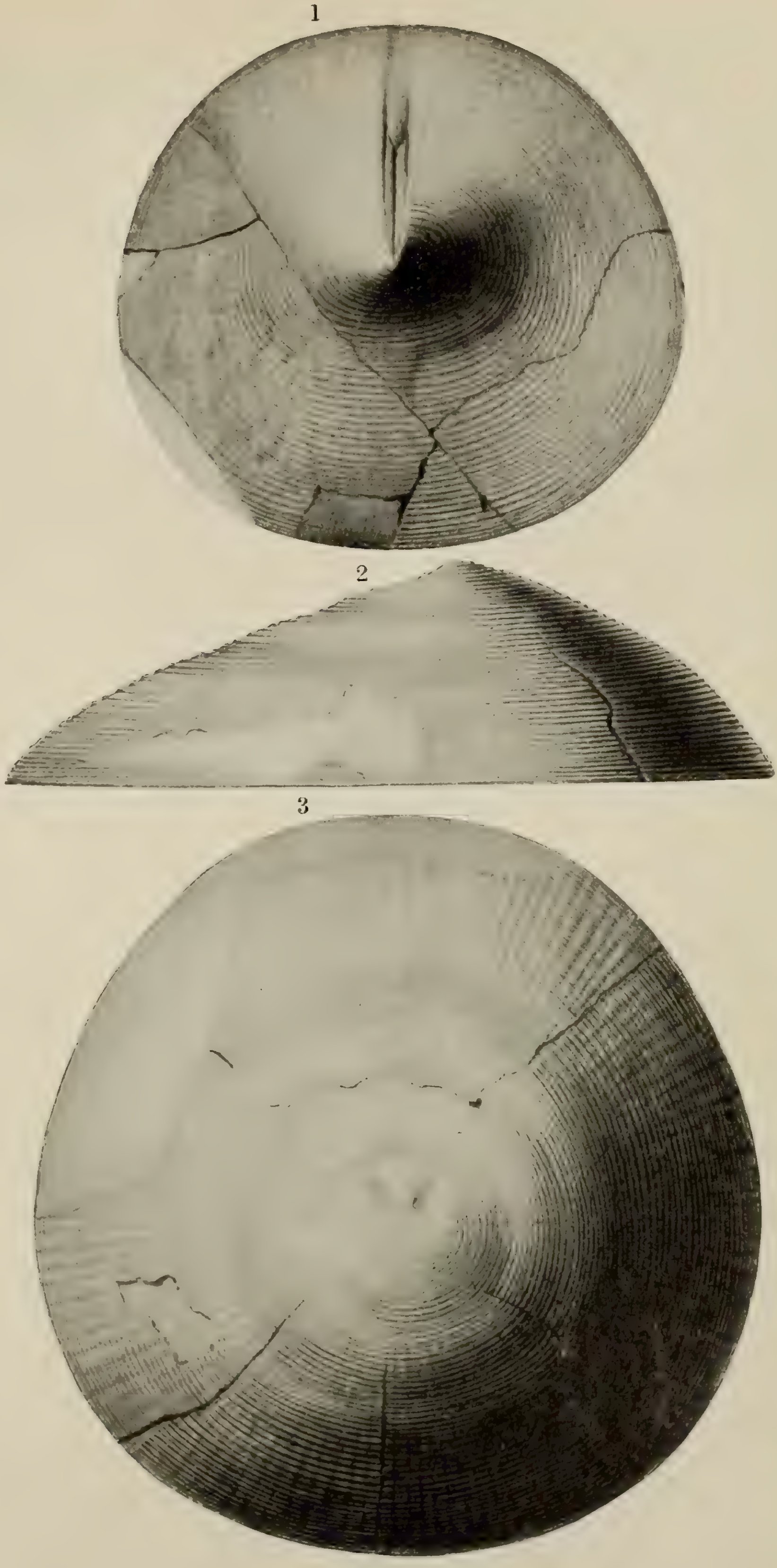

Plate 32

Lingula scalprum Clarke

Fig. 1, 2 Dorsal and ventral valves
Locality: Ponta Grossa, Brazil

Lingula lepta Clarke

Fig. 3, 4 Valves showing outline and muscular scars
Locality: Ponta Grossa, Brazil

Lingula keideli Clarke

Fig. 5, 6 Ventral and dorsal valves
Locality: Ponta Grossa, Brazil

Lingula lamella Clarke

Fig. 7 Conjoined valves
8 Dorsal valve with trace of median septum
Locality: Ponta Grossa, Brazil

Lingula subpunctata Knod

Fig. 9 Cast of ventral umbo showing pedicle slit

Problematicum

Fig. 10 Figure of a round cystoid body with a submarginal perforation or puncture from which radiates a pustular ornament. x 2
Locality: Jaguariahyva, Brazil

Clionolithus priscus McCoy

Fig. 11 A series of clavate tubes of this boring sponge in a shell of Ptomatis moreirai. x 1.5
Locality: Ponta Grossa, Brazil

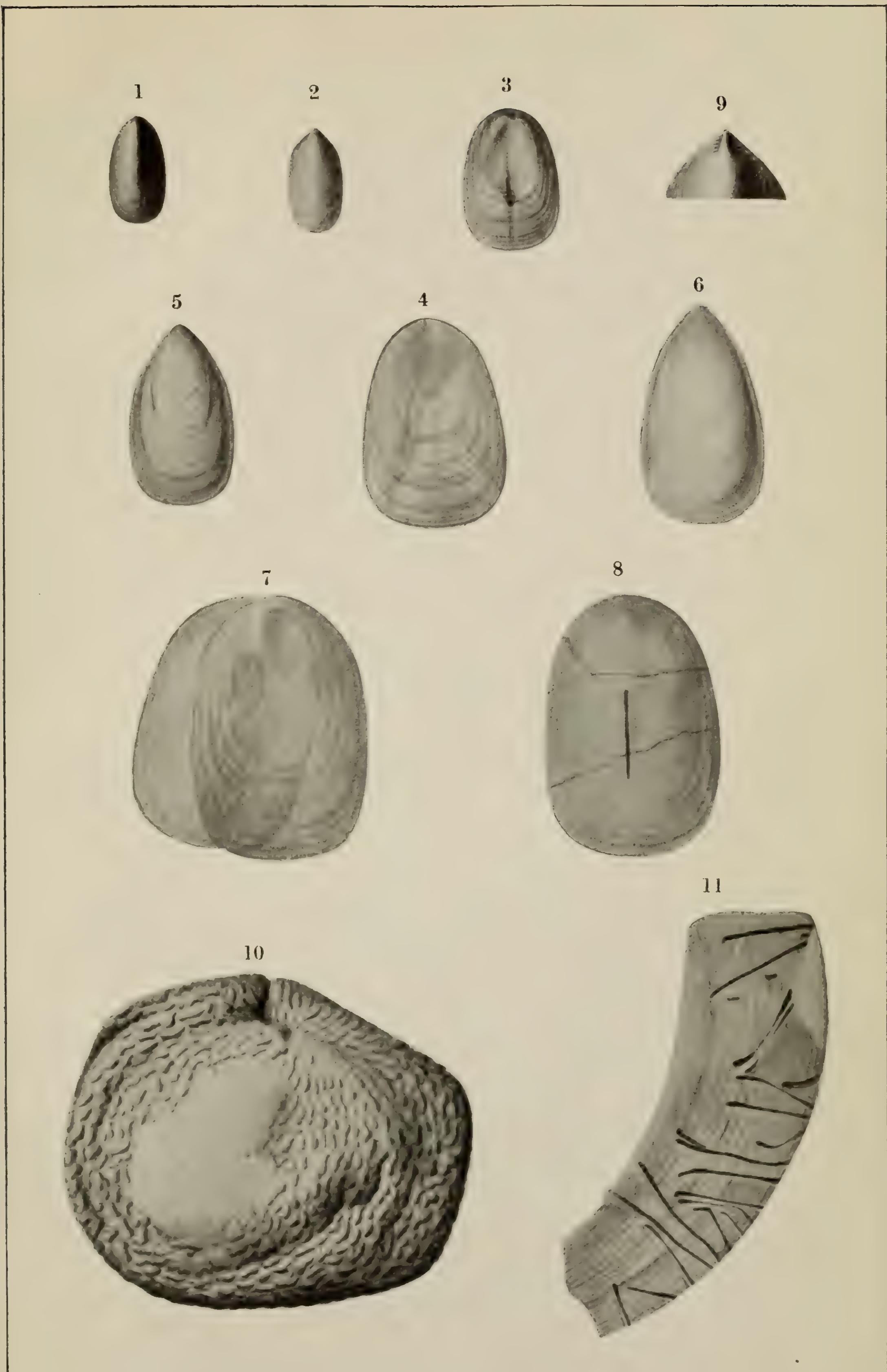
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Plate 33

Serpulites sica Salter

Fig. 1 Portions of flattened chitinous tubes with thickened edges
Locality: Ponta Grossa, Brazil

Plant (or branched annelid?)

Fig. 2 A frond or colony on which the branches are flattened clavate tubes taking origin from a clavate stipe. x 1.5
Locality: Ponta Grossa, Brazil

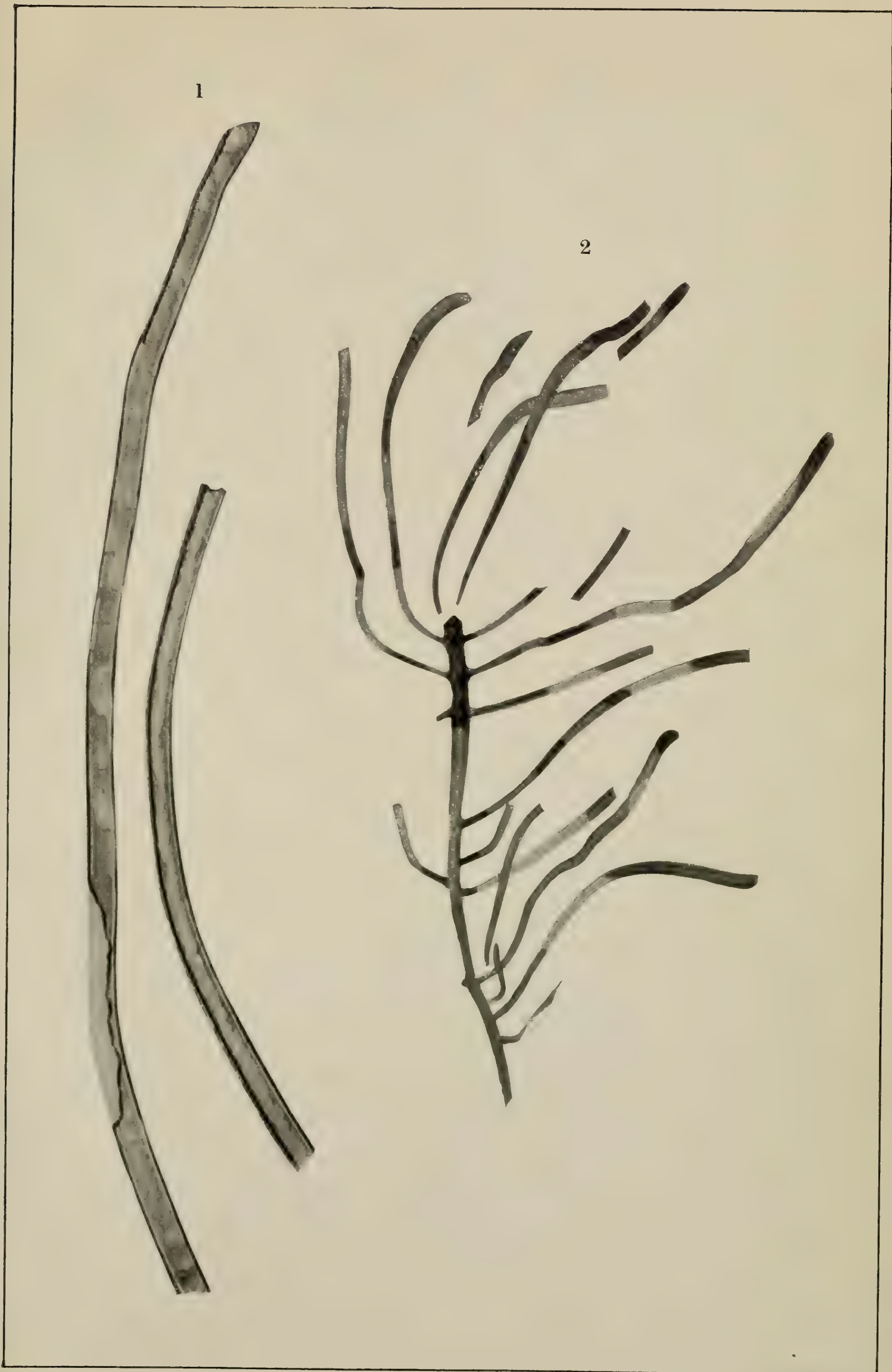
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Plate 34

Echinasterella? darwini Clarke

Fig. 1 Oral surface of an essentially entire specimen
2 Enlargement of part of arm
3 Madrepore plate. x 3
Locality: Ponta Grossa, Brazil

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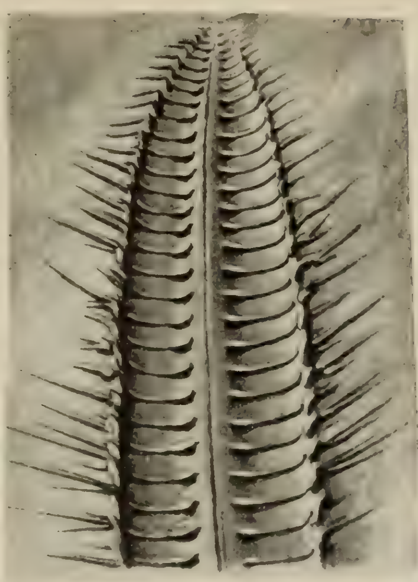

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Plate 35

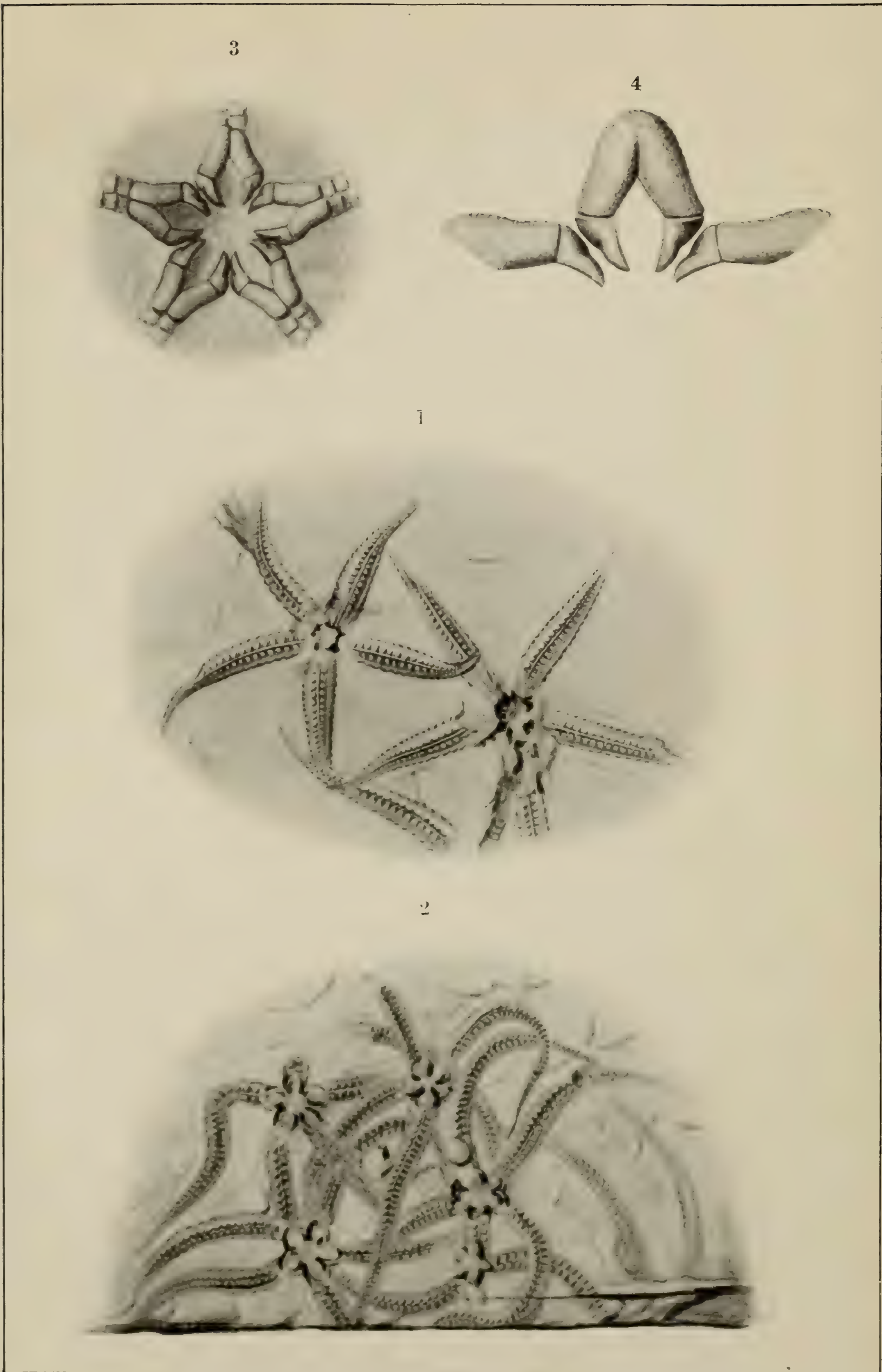
Aspidosoma ? pontis Clarke

Fig. 1, 2 Clusters of individuals in the soft shale, all exposing the ambulacral face

3 The entire oral apparatus. x 3

4 Part of oral frames and teeth. x 5

Locality: Ponta Grossa, Brazil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New York State Education Department

New York State Museum

JOHN M. CLARKE, Director

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4	Mineralogy	58	Mineralogy	113	Archeology
5	Entomology	59	Entomology	114	Geology
6	"	60	Zoology	115	"
7	Economic Geology	61	Economic Geology	116	Botany
8	Botany	62	Miscellaneous	117	Archeology
9	Zoology	63	Geology	118	Geology
10	Economic Geology	64	Entomology	119	Economic Geology
11	"	65	Paleontology	120	"
12	"	66	Miscellaneous	121	Director's report for 1907
13	Entomology	67	Botany	122	Botany
14	Geology	68	Entomology	123	Economic Geology
15	Economic Geology	69	Paleontology	124	Entomology
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